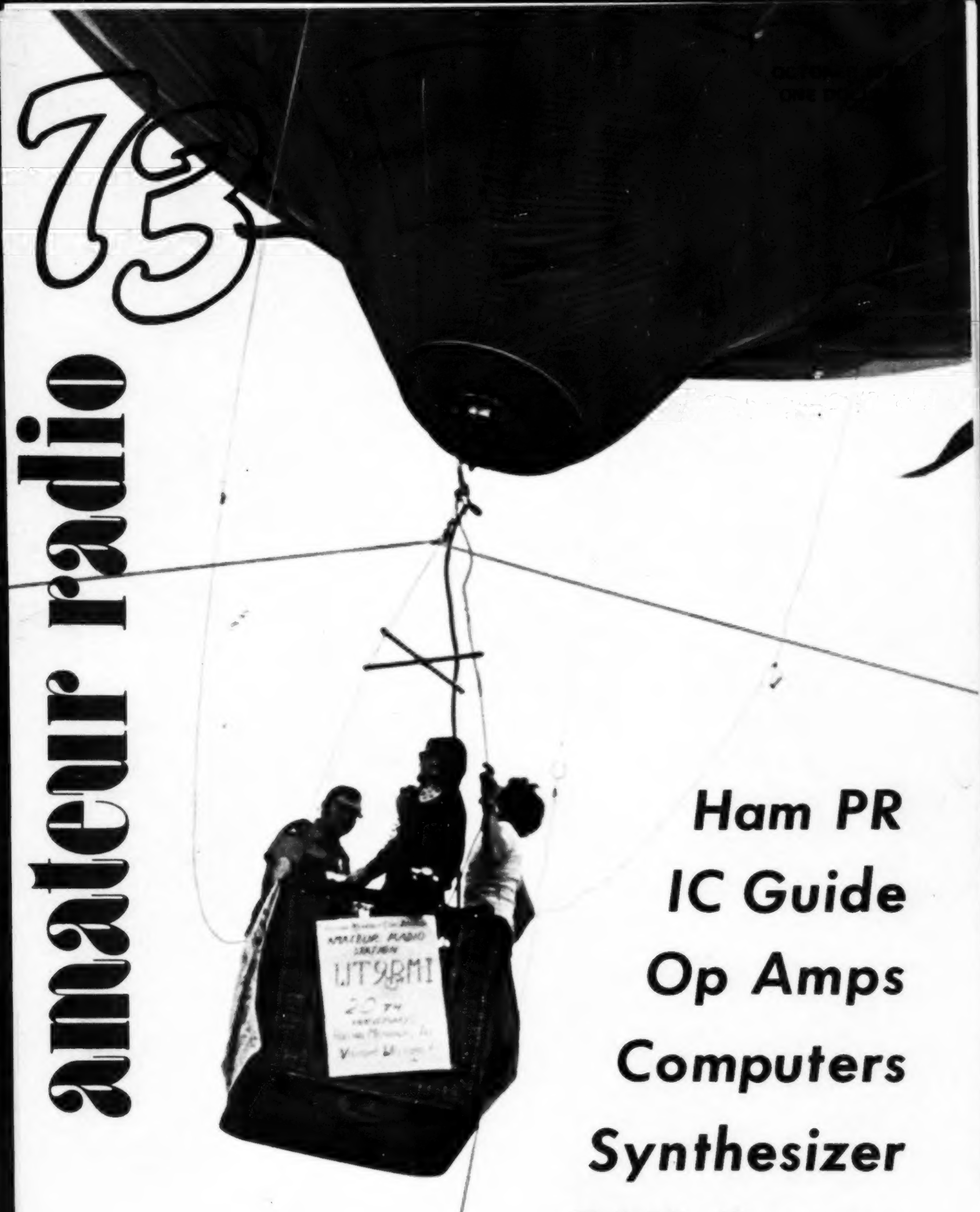
73 amateur radio

OCTOBER [illegible]
ONE DOLLAR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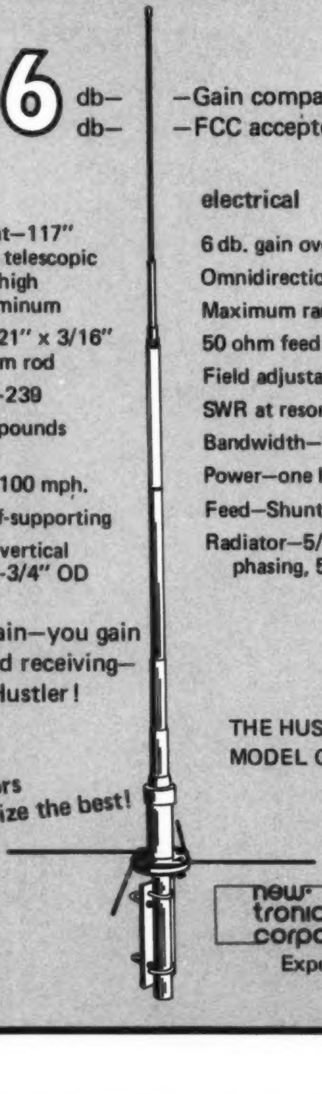

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73 amateur radio

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EDITORIAL BY WAYNE GREEN

ARE THE FUN MACHINES GOING SOUR?

A couple of years ago I began to notice a definite change in repeater operating. I thought it was just up in New England, but the more I got around the country, the more I found that the pattern was appearing just about everywhere.

Scene: A visitor in a new area with a two meter FM rig in his car. He kerchunks a repeater and finds that the signal is excellent. Next he calls in, using universally accepted procedure ... "K1FYP mobile one standing by." All is okay so far, but what happens next?

In most cases our visitor will hear absolutely nothing. In perhaps 20% of the cases he will be met after a few seconds by, "K1APA, this is WA1EJU, are you on frequency?" Thus our visitor knows that not only are there people listening to the repeater, but that they are going out of their way to let him know that they don't want to talk with him.

Does this happen on your repeater?

A recent visit to San Antonio resulted in this happening to me at least six times, with the only contact made being with another visiting mobile. I never did get an answer from one single local amateur! In Dallas I did a little better, but the result on most repeaters was as above. Ditto Phoenix and Albuquerque. Not ditto Salt Lake, thank heavens.

You don't have to be a visitor to have this happen to you either. I hear it happening every day to most ops who just come on and announce that they are available for contact.

Now, before you get uptight and defensive about this, let's take a look at a possible cause of this phenomenon. I suspect that it is a natural result of the present FCC regs. I won't go as far as to say that I think the rules are ruining FM, but a good deal of the fun sure has gone out of it for a lot of us.

The probable culprit, I suspect, is that abomination, the three minute timer. In the day when there were more operators than repeaters and there was some rational reason for limiting the time any user could talk, perhaps a timer made sense. But today, when most repeaters are just sitting there unused, timers serve no practical purpose. To the contrary, they put a heavy weight on any attempt at a contact.

So how many times will you call some chap who you don't know and go through the usual repeater routine of getting his name, what he is using, where he is located, and the over, before the clock turns the repeater off? The next brief burst of talk has no time to get anywhere and both of you decide the best bet is to just shut up and "leave the repeater for someone else to use." Baloney, they don't have any better use for it than you do, so it sits there silently, a monument to restrictive legislation.

If anyone figures out how to get an interesting contact going under these conditions, the pages of 73 are wide open. We desperately need a breakthrough like this to save FM and repeaters from a boredom which is almost beyond description.

Sure, once you get to know some chaps you can jolly with them, and you may even be able to get an interesting conversation going. It's rare, as any dedicated repeater listener will testify, but it does happen. But with a newcomer? Hardly ever.

Let's put it this way: If you ever chance upon a contact that you find really interesting on a repeater I sure wish you would quickly turn on a cassette recorder and tape it so I can hear this epochal contact. Surprise me and get me to apologize.

In the meanwhile, now that what's his name is out of the driver's seat at the FCC, let's see if we can get those repeater regs improved. Honestly, can you think of any good reason for a three minute timer these days? Just because commercial repeaters need them is not a valid reason for amateur repeaters. How about five minutes ... or even ten? If you'll give me ten minutes I'll not only talk your ear off, I'll be interesting ... and I'll have a chance to get you going on something that you enjoy and that I want to hear about.

Anyone out there feel like petitioning the FCC to get rid of that three minute nonsense?

Okay, I know, there are some repeaters where there are so many users that there just has to be a timer. But does this mean that *every* repeater has to have one? And I'll bet you that the no time out repeater will be a lot more interesting to monitor than the timed ones. Any takers on that bet?

If you listen around the country as much as I do, you'll soon find that about 90% of the repeaters are not being used 95% of the time, and that is a lot of non-use. Obviously something is wrong . . . if it isn't timers, what is it?

SUGGESTION

As an interim solution to this growing misery, perhaps some frank discussion at the next repeater club meeting might be in order. It wouldn't hurt to try to work out some stop-gap measures such as a firm vow to encourage those chaps monitoring the repeater to make an effort to be hospitable to visitors.

Even after almost forty years of trying to cope with getting into interesting conversations on the air I have little to offer. Sometimes the chemistry is there and we have a great time — sometimes there is no way in the world that I can get the other chap to make an interesting contribution to the contact. It's a lot easier with fellows I've known personally, of course, since we've had the opportunity to pursue some duplex eyeball conversations and have thus established some areas of mutual interest other than my magnetic mount antenna.

Tucker Electronics in Richardson, Texas. Well worth a visit if you get in the Dallas area. Fantastic selection of ham gear, new and used.

At any rate, let's try to do what we can to remember that FM means Fun Mode and make repeaters fun for everyone we hear coming through.

BYTE Trip

With more and more gear coming on the market for the computer hobbyist, and with the first issue of BYTE in the mail, I took off a few days to get out west and see first hand what was going on in the small computer systems business. Naturally I took along a 2m rig.

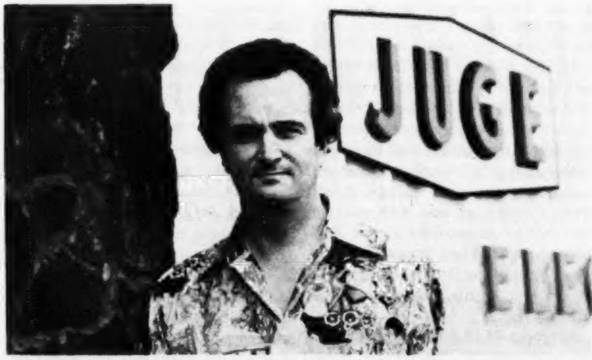
The first stop was Salt Lake and a visit to a brand new firm, Sphere Corp., which is getting ready to put out a Motorola M6800 based computer system. Their $650 kit includes a computer, keyboard and output for using a television set as a monitor. They had their system up and running when I visited, with a couple small bugs to work out before getting into full production (which should be a fact by the time this reaches print). Their plan is to use an audio cassette system for inexpensive bulk memory storage.

Next I visited MITS in Albuquerque, and got a good look at their Altair 8800 computer system which they have working. The Altair, which was introduced back in January, uses the Intel 8080 microprocessor chip, and MITS says they have shipped over 5000 units to date. The Altair runs $439 in kit form and $621 assembled and checked. I've had letters from many 73 readers who have put this one together.

My next stop was Southwest Technical Products in San Antonio, where I got a real surprise. SWTPC has been selling an inexpensive television typewriter kit which is great for Teletype use, or as a computer input/output unit. I'd put one together a few weeks ago and it worked great. However, I don't recall the TV Typewriter even being mentioned during my visit . . . their soon to be released M6800 computer kit was the main subject. They had the unit working and gave me a demo. This should be ready in kit form by mid-November.

MITS had a couple of surprises for me. One was the news that they will soon be announcing an M6800 based computer in addition to their 8080 unit. The other was how well their 8800 system worked. They loaded the computer from a cassette with Basic language and it was soon ready for setting up programs of considerable sophistication. It was at about this time that I stopped thinking of microcomputer systems as being inferior to

Continued on page 126



Ed Juge in front of his place in Ft. Worth — just off the freeway. Ed is one of the nice guys in the ham business — so be sure to say hello to him.

BE MY GUEST

Visiting views from around the globe.

"Thank God for Amateur Radio"

73 is happy to be able to present this comment, along with the letter to which it refers. The Indian River Amateur Radio Club of Florida is certainly worthy of emulation. – Ed

This is my first letter to a ham magazine. I am writing in to protest the way I was treated while working for my Novice license. I do, however, want to say that I have met a few amateurs who did help me. But for the most part I was treated as if I did not exist. I did join an amateur radio club, only to find the club was of little or no help. When I would ask one of them to help me with code they would say they had no time. When I would ask one of them to help me with theory the answer was there was nothing they could do to help me. Well, the fact remains that I am one of those people who, finding a wall in front of him, will fight to overcome it, and I did – I have my Novice license and the thing that kept me going was the thought of being able to walk in and tell them that even without their help I got my license. Most people are not like that – if they hit a wall like that they give up. Proof of that is shown by the fact that I brought 3 friends who are very interested in radio to the club and only one of them stayed. I think these hams who think themselves so great had better wake up to the fact that they are going to lose to CB operation many would-be hams because of their way of treating newcomers.

Wayne S. Gateman WN1UXS
Newton Centre MA

This comment is in response to Wayne WN1UXS, who wrote in the August 75 issue that he had trouble getting help from local hams in Newton Centre, Mass., when he was working on his Novice ticket.

Well Wayne, this is also my first letter to a magazine, but my story is quite different. I am a 54 year old aspiring Novice, disabled from heart disease, having had open heart surgery twice in the past three years and been in the hospital 16 times in that same period. I learned the code in the hospital as I did the theory, BUT, and a BIG BUT at that, I had help. A lot of it too, and it all came from those guys that you referred to as "hams who think themselves great".

They found out about my desire to be a ham, one I've had for over forty years, but was always too busy to start. Then they brought me the appropriate ham publications to study, a key with an oscillator, and a code course on tape. They advised me on the purchase of my gear, put up my antennas, then invited me to join their club. They have contributed many hours of their own time in a school for aspiring hams. They annually put on an Amateur Radio Course through the local adult education system at our high school. It is a 16 week course, two nights a week, that only costs $2.00. The instructors are all members of the Indian River Amateur Radio Club. They volunteer their time. They have bought and given to eight libraries (four of them high school libraries) complete sets of ham publications.

Yes Wayne, they are a great bunch of guys. They enjoy their work and ham radio. A recent example of this is one which I was happy to participate in. A black family moved into an otherwise white neighborhood. No one burned them out. Instead they found out he was disabled and also a ham, so they put up a tower, rotor

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Keep Breathing

Down in the village last week, we ran across one of the local QRPers, newly entered on the Honor Roll. We had expected that this one would be happy. He was not.

"Sure I made the Honor Roll," he said, "but I'm right on the bottom level. Right as low as you can get. And with no action in some of the DXCC countries for fifteen years or more, and all those deleted countries, I'll most likely stay right on the bottom. Honor Roll? Big deal!!"

We thought this over for a bit, figuring that it would help to keep him talking. The QRPer shrugged at our urgings.

"Look," he said, "sure I started late and was not DXing until I was twenty eight years old. But with all those inactive countries plus those deleted ones, the only way I can gain on those high numbers is to out-live them. The only way, and already I'm getting around the bend myself. A long ways around the bend!"

Son of a Gun, what could we say to all of this? For truly the Honor Roll honors those who started early and stayed late. And a late starter may never get by the lower echelons. And it has been noted that those DXers with a strong hope for posterity remembrance and the burnishing of the family name are the ones who do not enroll their eldest son in an Ivy League college at a tender age but get him DXing. All you need is a half century ahead of you and you are bound to be among the honored. And the pure in heart and the avoidance of tobacco, alcohol, night air, wild women and other distractions will certainly help.

But most of all, keep breathing . . .

Reprinted from the West Coast DX Bulletin, *August 12, 1975.*

"count to three"

Here, reprinted from Communications News, *is an interview with Charlie Higginbotham, which provides some insight to how things are going with amateur radio FCC-wise. Reprinted by permission of* Communications News, *August, 1975, Ken Bourne K9GHR, editor.*

Charles Higginbotham, chief of the FCC's Safety and Special Radio Services Bureau, was recently interviewed by CN Managing Editor Ken Bourne on matters currently affecting two-way radio users.

Prior to his appointment, Higginbotham had been chief of the Industrial and Public Safety Rules Division. He joined the Commission in 1948 as an electronics engineer. Before coming to the FCC, he had worked with United Airlines and had served in the United States Navy. He attended the American University and is a registered professional engineer. He has participated in many areas of the Commission's responsibility including Broadcasting, Marine, and, for the last 20 years, has been involved in rulemaking and regulatory activities in the private landmobile and microwave services (Public Safety, Industrial, and Land Transportation). He is a Fellow of The Radio Club of America.

The following interview took place on June 5, and began with a discussion on the temporary stay issued by the United States Circuit Court of Appeals against granting licenses for operation on 900 MHz. (The stay has since been lifted, with respect to private and cellular systems.)

BOURNE: *Were any licenses about ready to be issued before the United States Circuit Court of Appeals ruling on the temporary stay?*

HIGGINBOTHAM: No. They were not. The temporary stay was issued some weeks ago. The only application we had pending, I believe, is one of the City of Chicago. I believe that that was referenced in our filing with the Court. I believe we had one other application submitted on a Form 400 with a request for waiver that he be permitted to file, in advance of the availability of our attachment which the Commission adopted, and said we would not accept applications until the form was approved, and that form has not yet been approved. (Editor's note: Since this interview was made on June 4, the form was approved by GSA.) So that's where we stand. We are just marking time until we see what the Court does with the stay.

BOURNE: *Has any 900 MHz equipment been type-accepted by the FCC?*

HIGGINBOTHAM: I believe there is one piece of 900 MHz equipment type-accepted, by Motorola. That I believe is a conventional transmitter.

BOURNE: *How many proposals in the Safety and Special Radio Services Bureau are currently awaiting final rulemaking?*

HIGGINBOTHAM: We have Aviation, Amateur, Marine, Citizens and Land Mobile. I think we are fairly current on pending rulemakings. I don't believe we have very many loose ends hanging. The Commission recently concluded the Public Safety nonvoice rulemaking.

BOURNE: *That was just for Public Safety, correct?*

HIGGINBOTHAM: Yes. We had, a number of years ago, amended the Industrial rules to provide for the two-second nonvoice operations. The Public Safety rules in the Police and Fire area are a little bit different. They allow the continuation of the taped voice alarms, where they indicated there was a need for the patrolman on the street or the automobile to get a direct verbal message rather than some sort of a digital readout in the car.

BOURNE: *Speaking of nonvoice, do you personally expect ATIS (the FCC's proposal for automatic transmitter identification systems) to work?*

HIGGINBOTHAM: It depends on what you mean by "work". If you are asking me if it's technically feasible, the answer to that is, I don't think there's any real question. We have systems in operation today in our various services, and each, of course, noncompatible with the others, but any one of them, I think, is probably capable of performing the automatic transmitter identification function. I think it gets to be more difficult when we start talking about devising a single system, because that means that you have to pick a system out — and

---

and a six element beam. It took three weekends, but it was a great experience. The food served by the grateful ham's wife made it all worthwhile.

You might ask who these guys are who are doing so much? Well they are the same guys who are part of a team at the Space Center which put Oscar 6 and 7 in orbit, our men on the moon, launched numerous Titans, Minutemen and Poseidons — and now have added Apollo/Soyuz to that long list. They are also the local Little League coaches, Sunday School teachers, Scout leaders, Coast Guard Auxiliary and whatever else you might want to add.

Yes Wayne, I feel sorry for you and your community if the local hams are indeed as you have described them. I find that hard to believe with my experience. Let us not judge them that way. Maybe you didn't approach them properly. Maybe your attitude wasn't just right. I don't know what it was, but I sure hope it has corrected itself.

Amateur Radio is alive and well here in the deep South, and if you or anyone reading this is ever in our area, PLEASE feel free to join us at our meetings. The coffee and donuts are on us.

Thank God for Amateur Radio and for the Indian River Amateur Radio Club.

Joe Rubino
Cocoa Beach FL

maybe one that is in current use or maybe one nobody uses— and then everyone has to convert to that. So I think there is some reluctance on the part of various manufacturers to proceed. Some of them feel that when you do that you freeze the state of the art. That may be true, I don't know.

BOURNE: *What would prevent, say, an unscrupulous dealer from programming in some "noncall signs" on a CB radio, once this went into effect?*

HIGGINBOTHAM: Nothing.

BOURNE: *Is there any way you can prevent that from happening by insisting on a particular design?*

HIGGINBOTHAM: In CB, at least some manufacturers have indicated maybe one way to do it is to build into it, at the factory, the serial number. That certainly is a workable system, if you bear in mind that probably any system that could be devised can be defeated. It's probably easier to jury rig the device by putting in phony call sign, if it's done by a dealer or service man. But that compounds our problem if we go the serial number route, because it means we then do not have a record of licenses, but a record of every transmitter sold. That could get to be a pretty big and expensive data file.

BOURNE: *The FCC has stated that the Class E CB docket has been deferred, pending the outcome of several other dockets, including ATIS. That would bring up the question, what would prevent a Class E CBer from purchasing an Amateur Radio transmitter on the 220 MHz band and putting it on Class E – whether it's 218-220 MHz or whatever your current thinking is for a Class E band?*

HIGGINBOTHAM: I think there is a very good chance that will happen.

BOURNE: *So that would defeat ATIS entirely, wouldn't it?*

HIGGINBOTHAM: Yes, it would. As a matter of fact, I think there is a good chance that if we have Class E, it will bring about some rise in unauthorized operation in the Amateur bands. I am more concerned about that than the other way. I think the bulk of CBers will not try to defeat the circuitry. You see, with the present system, with off-the-shelf equipment, and partly encouraged by dealers, maybe substantially encouraged by dealers, they have said, maybe in the interest of making an immediate sale, "I'll make this equipment immediately and to ensure that other people will talk to you, why don't you use a handle, and here is a list of handles." I know a lot of that is going on. In my speech at Las Vegas (NEWCOM show), I covered that point. I also admitted that, while I had some problems with the way the industry had gone, the FCC was not entirely blameless, because we sort of failed to try to shoulder our enforcement. And we have had and have unrealistic rules. Docket 20120 is intended to kind of get started towards bringing the rules into the real world. They still need a lot of reregulating. They need to be written in words that people can understand, and they could be less verbal. I think the fact that the Commission agreed to propose to expand the Class D Service indicated it hasn't given up hope of making a better order service out of it.

BOURNE: *But just listening to it, it almost sounds hopeless. Do you, personally, listen to CB?*

HIGGINBOTHAM: I have to confess I don't. I've been thinking about buying a unit and setting it (in my office).

BOURNE: *How about the Commissioners? Do any of them listen to CB?*

Continued on page 97

Dig it out and loan it

At various times comments have appeared emphasizing the need to get more young people involved in Amateur Radio. At the present time junior high and high school students are not financially encouraged to stick with ham radio. Think about the prices you saw last time you browsed through your local radio dealer's showroom. Even the most basic, used Novice station will cost about $100. For a young student that is a tremendous amount of money.

And then think of how you might react if your son (or daughter) came home and announced that he wanted to spend all of his savings on an old battered piece of hobby equipment. And if the Novice does persist and get his General license, the situation does not improve. Even the simplest SSB station will cost $500 or so when you include the power supply and a microphone. Think about when you were in high school. It was hard enough to save $30 so you could take your girlfriend to the prom. It must be a bit discouraging for young hams to look at the "bargain" prices of ham rigs advertised in the magazines.

The young ham might get a part time job, but it won't be easy for him to go to school, do his homework, a few chores around the house, work part time, and still have any time left to do some operating.

As for building, it is impossible for an inexperienced builder with a small junk box to build a complex multiband SSB rig with the same versatility and ease of operation as the commercial equipment for a lower price.

So, what can we do about all this? Well, for starters, remember that old Novice rig of yours that is stored away in the corner of the basement? Dig it out and loan it to that junior high boy who just passed his Novice test. Spend a few minutes showing him how to use it and you won't have to worry too much. I can guarantee that the rig will get some use instead of gathering dust.

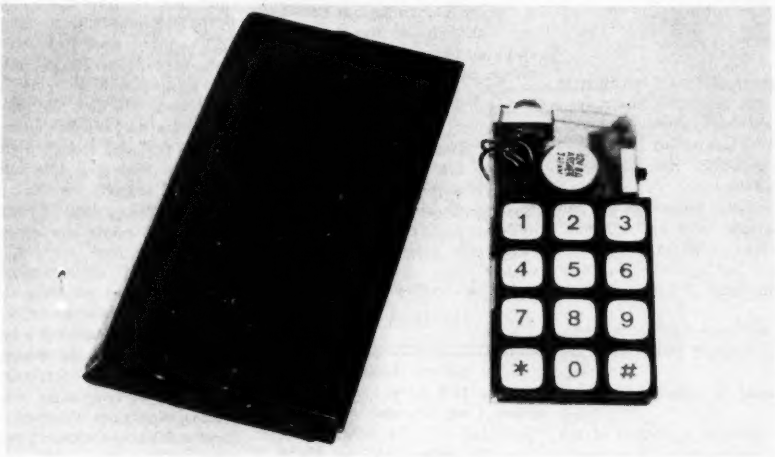
Or, invite a Novice over to your shack some evening and let him work some DX. Very few Novices have a beam or a linear, and would get a thrill out of using yours for an hour or two.

Help the high school radio club set up a station. If your local radio club doesn't have a club station, set one up and make it available!

It doesn't take much on your part and it might stop some valuable young hams from dropping out.

Mark Aaker WB9NAI
Eau Claire WI

NOW you can REALLY CARRY it with you!



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LETTERS

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Gentlemen:

Many thanks for your fast efficient service. I was dazzled! It's been years since I had such courteous service. The $6 order was mailed 26 July and the semiconductors were received 31 July. Unbelievable!

My two meter transceiver was out of service due to a bad LM380N. Gratitude is extended for:

1. Not putting the customer through the hassle of a $20 minimum order.
2. Not waiting 4 weeks to see if the customer's personal check clears the bank.
3. Shipping the order on the day of receipt.
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Would you kindly send an additional catalog for the company engineering department catalog file?

May you enjoy much business success.

Yours Truly,
Richard A. Drew, P.E.
Electrical Engineer
Wisconsin Rapids WI

THE BAD...

After reading about "The Bad" Trigger Electronics in your August issue, I just had to write to you and tell you of another outfit that seems to operate the same way, 73 Magazine.

On June 9, 1975, I mailed you a check for $4.00 for a DX bearings chart. Some weeks later I found that I did not need this chart and since I had not received it anyway, sent you a letter requesting that you cancel the order and refund my $4.00 which has cleared my bank. I followed up two weeks later with another letter requesting the refund and as of this date have not received either the chart or the refund. Please send the refund and remember that "People who live in glass houses shouldn't throw stones at Trigger Electronics" or something like that. I doubt that this will get into your letters column but maybe it will get my $4.00 back.

Len Malone WB8PTP
Cincinnati OH

Sorry. This confusion and our inability to process your order properly were directly traceable to "summer vacation devastation". We have sent you a check for $4.30 (your $4.00 plus postage for your three letters). – Ed.

AND THE UGLY

I just got my August issue of 73 and the first thing I read was the letters. I was interested in the article, "The Bad...", by Scotty Bottom from Worcester MA. In March I ordered the Johnson Viking Match Box for $94.95. I also sent a check for $96.55, to cover all costs. A month later I got the canceled check. My father and I have called Trigger four times. Each time Miss Dolly gave us the run-around. The last time we canceled the order and asked for our money back.

Nothing happened, so we wrote the Chamber of Commerce in River Forest IL. They contacted Trigger. A few days later we got a notice from Miss Dolly saying that we would be soon receiving my money. It has been two weeks and nothing has happened.

We will soon be going to the Post Office to complain of mail fraud.

Wesley J. Larsen WN3ZHT
Frackville PA

Mr. Larsen also submitted photostatic evidence of the bases for his complaint and – unfortunately – every word in his letter appears to be the truth. – Ed.

A BOUQUET

In these days of so many moans and complaints, I think a bouquet is deserved. Your special rate 2000 QSLs have been received. I'm very pleased with the printing and the QSL itself. Thanks for the bargain!

H. Gordon Wightman VE5XU
Regina, Saskatchewan

USEFUL AND CHEAPER

I have been receiving QST for many months now, and have learned absolutely nothing from it. As a beginner in the electronics field, I find that the QST editors bore me with their elaborate technical articles, seeming to have no consideration for the beginner and Novice. The days are few and far between when I can pick up my latest issue of QST and actually understand what I'm reading. I think they are centering around the EE with a college degree, a load of cash in his pocket, and a junk box a mile high. The average ham with a general knowledge of electronics and a modest income doesn't, in my opinion, give a blankety-blank about i-f responses in his double-balanced mixer, or building a converter for Oscar. The interest just isn't there, and you can't force it by constantly printing that type of article. Surely those articles are important and mean a lot to many hams, but they have their place and time. They belong in the publications, but WHY SO @¢–*# MUCH??? I'm sick and tired of reading about docket 20282, the RFI Bill, and the ARRL's beloved National Convention. QST's attitude is going to wipe me off their subscription list... and very soon.

If you think I'm an old man of 150 babbling away, you're wrong. I'm a 16 year old Advanced licensee, and I feel we need better articles in our publications – different antenna designs and construction stories, NOT JUST TWO METER FM, but everything else as well. We need more USEFUL and CHEAPER projects to build – good practice for the beginner. And HEY, Mr. GENERAL, Mr. ADVANCED, and Mr. EXTRA CLASS, how about a helping hand to those little Novices and soon-to-be operators over there? Because who's going to operate when you're gone? I think QST has done nothing except make money, and I've had enough of it.

I read our club's 73 magazine today, and I'll be reading theirs no more, since I'll be getting my own subscription soon. I've found 73 to be fascinating, filled with projects and ideas that are a reality to me. Real down-to-earth articles, some with humor. Who says Wayne Green's nuts? I think he's got a good thing going, and he shouldn't give up, no matter what people think. My QST subscription will soon be canceled, and guess who'll get the cash? 73 Magazine!!

Steve Reed KP4EAI/KP4USN
Sabana Seca, Puerto Rico

GOOD GRIEF

Good grief, Wayne, "Don't Feed the Bears," in the August 1975 "73" is too much. I always considered you to be somewhat selective in your choice of articles but one more like that and . . . (*censored*) . . .

Bob Myers K3HWL
Meadville PA

TTL ENLIGHTENMENT

I am not an amateur radio operator, but have been involved in electronics for the past 9½ years, working with missile systems, radars, computer peripheral equipment, commercial radio equipment and data communications. I subscribe to 73 for a number of reasons; the most important one is the practical application of electronic theory with everyday technical problems. I have just read the article titled *The Best Logic Yet* by William E. Browning WB5IRY in the August issue and find that I must comment on what I consider to be some basic flaws in his thoughts on TTL Circuitry.

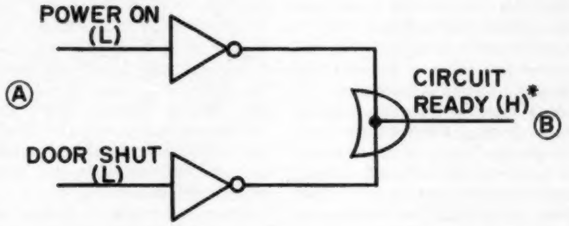
One statement that he made was, "Do not connect two outputs together". This should have read, "Do not connect two outputs together unintentionally," since there are several times that two outputs ARE connected together to perform a certain function such as in "Wired 'OR'" applications (as shown in the accompanying example), as well as in other applications (also shown). I have been involved in using TTL logic for several years and once taught the subject in a commercial school. This logic is indeed easy and probably the "best yet," particularly for the person who has never worked with logic ICs before, as Mr. Browning pointed out in his article.

Future articles should point out the various circuit configurations which are presently being used commercially. (Such a task, though seemingly difficult, is really easy since a book published by the technical magazine *Electronics* is available at a relatively low cost – the title is "Circuit Designer's Casebook". The address of the magazine *Electronics* is: 1221 Avenue of the Americas, New York NY 10020.)

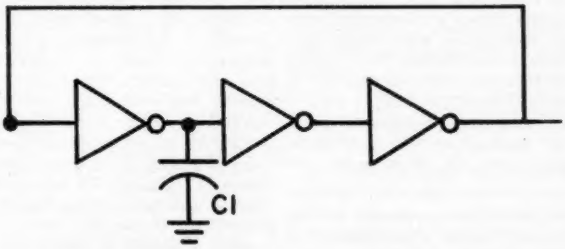
I hope this letter will enlighten some of your readers about TTL logic and its uses.

Roy M. Hein, Jr.
Livonia MI

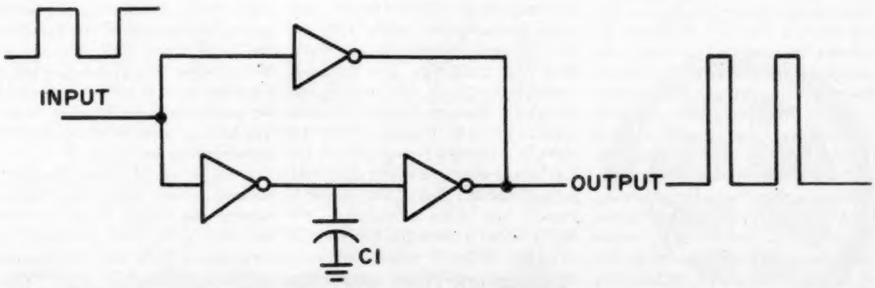
Continued on page 19



*Any high condition at the input (A) will force a low at the output (B). *"( )" indicates signal condition for a "true".*

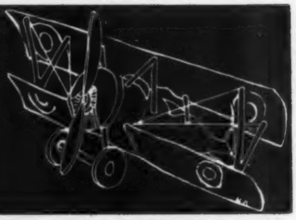


This circuit is a free running multivibrator. The frequency is determined by the value of CI and the IC's internal circuits. It costs about 25¢ to build and I have seen it used from a TC of 1 sec to 1 MHz.



This is a "one shot" circuit sometimes referred to as a "cheap shot", since it is cheaper to use than other devices. C1 determines the pulse width of the output, e.g., 10 uF produces about a 10 usec width pulse.

Autobiography of an Ancient Aviator



W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230

$7.50 for 10 Min.

Soon after I had gotten back to Brooklyn from delivering the LWF plane to Hal Bazley in Boston, I heard that Juan Trippe had some boxed Aeromarine 39b seaplanes that he needed help in setting up. They were located in a hangar at the inactivated Naval Air Station at Rockaway, Long Island. I got Art Caperton to join me on a journey to the N.A.S., where we talked with Trippe. He said he wanted to set up one of the ships to survey a possible airline route from the East River at Manhattan to Southampton, Long Island. We agreed to set up a ship for him, if we could set up another for our use in passenger carrying at Port Washington. The 39b was a biplane with a single pontoon under the fuselage and small wingtip pontoons. It was equipped with a Curtiss OXX6 engine that was supposed to put out 100 HP.

It only took us a week to set up the two seaplanes and test them. These ships were not ideally suited for making money at passenger hopping. They had only two single seat cockpits, the aft one for the pilot and the forward one for a $7.50 for ten minutes passenger. One week was enough to convince us that we weren't going to have enough money to keep it up. At this juncture we were both fortunate to have other flying jobs offered. Caperton was recruited to fly mail from New Orleans to Pilottown, at the southern tip of the Mississippi delta, in HS2L flying boats. Gillespie, of Heller Field, Newark, N.J., wanted me to fly a Curtiss R4 landplane that he was assembling near Middletown, Pa. We each accepted our offer and I notified Trippe that we were turning his 39b back to him. I flew the ship to a seaplane base at College Point for fueling. Trippe joined me there and flew the ship to Sheepshead Bay, Brooklyn, where I disembarked, and he went on to the N.A.S., Rockaway. A few years later Juan Trippe started Pan American Airways with a flying boat service between Key West, Florida and Havana, Cuba. As almost everyone knows, he built Pan American into one of the largest international airlines in the world.

He owned a dozen pairs of leotards . . . which served as his underwear as well as his performing uniform.

Although the Naval Air Station had been decommissioned and there were no Navy activities, a maintenance crew and several watchmen were stationed there. Trippe, Caperton, a mechanic and I were lodged in a barracks. It was interesting to see the great number of cases of ------y (your first guess was correct) that were landed there and loaded on trucks for further transport. I got a lift on one of the trucks one night to a place where I could get a subway to Brooklyn. We sailed right through with no interference at all — and only one stop to pay a "toll".

When I arrived at Middletown I found that they had the R4 nearly ready to attach and rig the wings. A 220 HP Hisso engine had been installed and the center section and tail surfaces all rigged. The ship was really an overgrown Jenny with the front cockpit enlarged to accommodate four passengers. The ship was owned by Pat Doyle, who proposed to barnstorm through western Pennsylvania and West Virginia under the name of "Doyle's Flying Circus". He had hired a wing walker and parachute jumper named "Baby Otto Hoover". Hoover was quite a character. He owned about a dozen pairs of leotards of many different colors with contrasting trunks to go with them. These served as his underwear as well as his performing uniform. All he needed was a purple cape and a big red "S" on the front of his leotards to look like Clark Kent.

By September 12th the ship was ready to go. Of course the field where we had done the final assembly was small and completely surrounded by high tension wires, but it was available. That morning, however, there was a good breeze blowing the long way of the field so I took the ship off with no trouble and flew it the few miles to the Air Service Middletown Air Intermediate Depot field. The Commanding Officer of the field came out to greet me personally with orders to "get that crate the h - - - off the field". I told him that a few things had to be done to put the ship in flying condition and that the owner and his mechanic would be there soon to make the necessary adjustments. He finally agreed to let us keep the ship there overnight. He even sent some men out to tie it down for the night. My reserve officer's ID card helped, I guess. Doyle and Hoover arrived about an hour later and we rerigged the wings so they didn't flap quite so much. The boys on the gas truck came out after dark and filled our gas tank for a couple of dollars.

Hoover jumped and landed in the middle of the Susquehanna river, surprising the crowd which was expecting him to land in the park.

Next morning, after a test hop, we piled all our gear, including Hoover's two parachutes, Doyle and Hoover, into the front cockpit, and flew to a field just south of Harrisburg where we could leave the ship for the night. Harrisburg was having some kind of a celebration the next day and Doyle had contracted with the committee to have the plane fly over Riverside Park where they were having the doings, do a few stunts, and put on a wing walking exhibition and a parachute jump. So we did the show and Hoover jumped and landed in the middle of the Susquehanna River in about two feet of water. Embarrassing, as he was supposed to have landed in the park. His chute was very large, so it gave him time to perform on its attached trapeze on the way down.

A couple of days later we got to Hanover, where they were having a carnival. We stayed there four days and did quite well carrying four passengers at $7.50 each on about 25 flights a day.

Pat Doyle had made advance arrangements for a performance of our show and several days of passenger-carrying at Elkins, W. Va. We arrived there safely on the afternoon of September 11th and landed on a hillside meadow on Dice Harper's farm.

I learned a few things about Pennsylvania mountain flying on that trip. First of all, the R4 loaded down with the three of us and all our gear did not have a ceiling high enough to get us over some of the higher ridges.

I learned a lot about bouncing over fences on short field takeoffs.

So when we came to a high ridge we would have to fly alongside it until we either found an updraft that would take us over or a pass we could get through. We did quite a bit of wandering up and down valleys.

We based in Elkins for about three weeks, making side trips to several nearby towns to put on shows at $200 each with $50 more for a parachute jump. We also did quite a lot of passenger carrying from small local fields. I learned a lot about bouncing over fences on short field trakeoffs and landings, and also about hillside operations. I had to be my own mechanic, too.

Next month — the R4's curtain call and more LWF flying, including a lucky close one. So don't be so uptight about life. No one ever got out of it alive.

AZ-EL PROGRAM

A program, written for the Hewlett-Packard programmable calculator (HP-65) is available for computing both azimuthal and elevation coordinates (az/el) for tracking either Oscar 6 or 7. Once the satellite orbital data and individual QTH positional coordinates are inputted and stored, the routine will compute az/el antenna pointing coordinates for any number of arbitrary, specified times following the ascending node. Az/el coordinates computed with this routine for both ascending and descending passes agree favorably with both the results of a FORTRAN program run on a CDC-3800 computer and with actual observed satellite trajectories. The program can be stored on a single HP-65 magnetic card. Documented copies of the program will be forwarded upon request and receipt of an SASE; if a blank magnetic card is included with the request, a copy of the program itself will be sent.

Earl F. Skelton WA3THD
1901 Deerfield Court
Washington DC 20021

Oscar 6 Orbital Information				Oscar 7 Orbital Information				
Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Oct)	Time (GMT)	Longitude of Eq. Crossing °W
13529	1	0151.5	78.7	BX	4001	1	0115.9	68.8
13541	2	0051.4	63.7	A	4013	2	0015.3	53.7
13554	3	0146.3	77.4	B	4026	3	0109.6	67.2
13566	4	0046.3	62.4	A	4038	4	0008.9	52.1
13579	5	0141.2	76.1	B	4051	5	0103.2	65.6
13591	6	0041.1	61.1	A	4063	6	0002.5	50.5
13604	7	0136.0	74.9	B	4076	7	0056.8	64.0
13616	8	0036.0	59.9	AX	4089	8	0151.1	77.6
13629	9	0130.9	73.6	B	4101	9	0050.4	62.4
13641	10	0030.8	58.6	A	4114	10	0144.7	76.0
13654	11	0125.8	72.3	B	4126	11	0044.1	60.8
13666	12	0025.7	57.3	A	4139	12	0138.4	74.4
13679	13	0120.6	71.0	B	4151	13	0037.7	59.3
13691	14	0020.6	56.0	A	4164	14	0132.0	72.8
13704	15	0115.5	69.8	BX	4176	15	0031.3	57.7
13716	16	0015.4	54.8	A	4189	16	0125.6	71.2
13729	17	0110.4	68.5	B	4201	17	0024.9	56.1
13741	18	0010.3	53.5	A	4214	18	0119.2	69.6
13754	19	0105.2	67.2	B	4226	19	0018.6	54.5
13766	20	0005.2	52.2	A	4239	20	0112.9	68.0
13779	21	0100.1	65.9	B	4251	21	0012.2	52.9
13791	22	0000.0	50.9	AX	4264	22	0106.5	66.4
13804	23	0055.0	64.7	B	4276	23	0005.8	51.3
13817	24	0149.9	78.4	A	4289	24	0100.1	64.9
13829	25	0049.8	63.4	B	4302	25	0154.4	78.4
13842	26	0144.8	77.1	A	4314	26	0053.7	63.3
13854	27	0044.7	62.1	B	4327	27	0148.0	76.8
13867	28	0139.6	75.9	A	4339	28	0047.4	61.7
13879	29	0039.6	60.8	BX	4352	29	0141.6	75.2
13892	30	0134.5	74.6	A	4364	30	0041.0	60.1
13904	31	0034.4	59.6	B	4377	31	0135.3	73.6

AMSAT-OSCAR 6's THIRD BIRTHDAY!

October 15, 1975 marks the third anniversary of the launch of AMSAT-OSCAR 6. One of two long-lifetime spacecraft now in orbit, AMSAT-OSCAR 6 has now exceeded its original one-year lifetime goal by 200%.

To mark the occasion, special bulletins will be transmitted via the AMSAT-OSCAR 6 two-to-ten meter transponder on the evening of Tuesday, October 14 (October 15, GMT). These satellite transmissions can be heard on approximately 29.50 MHz with most HF receivers and antennas. The times of satellite passes that can be heard over most of North America are:

Orbit 13704 — 9:28 pm EDT (± 10 min.), Tuesday evening, Oct. 14 (Oct. 15 GMT);

Orbit 13705 — 8:23 pm PDT (± 10 min.), Tuesday evening, Oct. 14 (Oct. 15 GMT).

An attractive, multi-color AMSAT-OSCAR 6 QSL card is available for stations reporting reception of these transmissions. Give the time, signal strength, and call letters of the bulletin station, describe your receiving equipment, and send this information along with an SASE to "AMSAT-OSCAR 6 Report," P.O. Box 27, Washington DC 20044.

amsat ™

CONTESTS

Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

RTTY ART CONTEST

Starts: October 1
Ends: November 30

All worldwide licensed radio amateurs and members of their immediate families (except officials and judges of this contest and members of their families) are eligible to participate in this contest. Entries must have been originated by means of manual inputs to a teleprinter using a standard communications keyboard, and may be submitted only by the originator of the art, or by the amateur on behalf of a family member. Submitted art may be of any subject suitable for transmission via amateur radio. Entrants may submit as many entries as desired, and each entry shall be given a short title. Submitted art may contain overline shading. Tapes of entries shall be formatted to permit a reasonably short running time, and to be compatible with machines which do and do not downshift on space. Compatibility with machines which interchange the bell and apostrophe is not required. At least three functions must be used between each line, normally: CR, LF, LTRS. Each line of the art shall be limited to a maximum of 72 characters (including spaces) and tapes to a maximum running time of 40 minutes at 60 wpm for the art itself, exclusive of any other information on the tape.

Each entry must have been transmitted for the first time via amateur radio after October 1st and must be accompanied by a confirmation of at least one receipt of its transmission, identifying the title of the art and the call letters of the receiving and transmitting stations. All confirmations must be in writing (not by RTTY transmission), and must have been obtained by the entrant from the receiving station. Entrants may obtain necessary transmission of their entry by any amateur radio station. The tape and prints of each entry shall carry the full name of the author, call letters of the submitting station, and mailing address. This information shall be both written upon a beginning leader of the tape and also punched in the tape to appear on page copy when reproduced. Entrants must submit one five-level paper tape and five prints of each entry and by such submission agree that the tapes and prints may be used, duplicated and published for any purpose.

AWARDS:

Entries will be judged on the originality of the author in selection of subject matter, on excellence of technique in producing the art and formatting the tape, on overall appearance of the art when viewed from a distance, on suitability for publication, and on the entrant's compliance with these rules. A committee of judges, made up from individuals who have exhibited an interest in RTTY art, will select first, second, third and honorable mention winners. Winning entrants will receive a plaque for first place and certificates for other places. Winning entries will be published in the RTTY Journal and other amateur radio magazines. The decisions of the judges shall be final.

ENTRIES:

Tape, prints and transmission confirmation information should be securely packaged and sent to: RTTY Art Contest, c/o Don Royer WA6PIR, 16387 Mandalay Drive, Encino CA 91316 USA. Entries must be postmarked prior to December 1, 1975. Entries will not be acknowledged nor returned. Winners will be announced as soon as possible after the closing date.

Note: Since mail damaged tape will be of little value, it is suggested that tapes be wound tightly upon a hard core.

VK/ZL/OCEANIA DX CONTEST

PHONE
Starts: 1000 GMT Saturday, October 4
Ends: 1000 GMT Sunday, October 5
CW
Starts: 1000 GMT Saturday, October 11
Ends: 1000 GMT Sunday, October 12

WIA and NZART invite all amateurs to participate in the 1975 VK/ZL/Oceania DX Contest in which the rest of the world contacts stations in Oceania but with emphasis on ZL and VK.

EXCHANGE:

The exchange will consist of five or six figures made up of the RS(T) report plus three figures which should start with 001 and increase by one for each successive QSO.

SCORING:

For Oceania stations (other than VK/ZL) score 2 points for each QSO on a specific band with VK/ZL and 1 point for each QSO on a specific band with the rest of the world. For the rest of the world (other than VK/ZL) score 2 points for each QSO on a specific band with VK/ZL and 1 point for each QSO on a specific band with Oceania stations other than VK/ZL.

FINAL SCORE:

Multiply the total QSO points by the sum of VK/ZL call areas worked on all bands. The same VK/ZL call area worked on different bands counts as separate multipliers.

AWARDS:

Attractive colored certificates will be awarded to each country (call area in USA, Japan and USSR) on the following basis: top scorer using all bands, separate awards for phone and for CW.

SWL SECTION:

To count for points, a VK or a ZL station ONLY must be heard in a QSO and the following details noted in the log: date, time (in GMT), call of the VK or ZL station heard, callsign of the station he is working, RS(T) of the VK/ZL station heard, serial number sent by the VK/ZL station heard, band and points. Scoring is on the same basis as for the transmitting section and the Summary Sheet should be similarly set out.

LOGS:

Logs must show, in this order: date and time in GMT, call of station contacted, band, serial number sent, serial number received. Underline each new VK/ZL call area contacted and make separate logs for each band used. A Summary Sheet must be included, showing: callsign, name and address (use block letters please), details of equipment used, and for EACH BAND, QSO points for that band and total of VK/ZL call areas worked on that band. All band score will be total QSO points multiplied by sum of VK/ZL call areas on all bands while single band scores will be that band's QSO points multiplied by

VK/ZL call areas worked on that band. Also, sign a declaration that all rules and regulations have been observed. All logs should be posted to reach the contest manager before 31 January 1976. Send all logs to: VK/ZL Contest Manager, WIA, GPO Box 1002, Perth, West Australia 6001. All logs are greatly appreciated!

YL ANNIVERSARY PARTY

CW
Starts: 1800 GMT Wednesday, October 15
Ends: 1800 GMT Thursday, October 16

PHONE
Starts: 1800 GMT Thursday, November 6
Ends: 1800 GMT Friday, November 7

All licensed women operators throughout the world are invited to participate. YLRL members only are eligible for the cup awards. Non-members will receive certificates. Only YLRL members are eligible for the Corcoran Award. Contacts with OMs do not count. All bands may be used but cross-band operation is not permitted. Only one contact with each station will be counted in each contest. General call will be "CQ YL".

EXCHANGE:

QSO Number, RS(T), ARRL section or country.

SCORING:

CW and phone will be scored as separate contests. Submit separate logs for each contest. All YLs located within an ARRL section, score one point for each QSO with another station located within an ARRL section. Score two points for each contact with a station not located within an ARRL section. All stations not located within an ARRL section shall score two points for each contact with a station located in an ARRL section. Score one point for each contact with another station not located within an ARRL section. Section lists are available from WA6ISY; please send an SASE. Multiply the number of contact points by the total number of different ARRL sections and/or countries worked. Stations running 150 Watts input or less on CW may multiply their score by 1.25. SSB stations running 350 Watts PEP or less at all times may multiply their score by 1.25.

AWARDS:

GOLD CUP – to highest CW YLRL member, anywhere in the world. GOLD CUP – to highest phone YLRL member, anywhere in the world. Certificates will be awarded to the first, second and third place CW and phone score (not combined) and the highest CW and phone log in each district and country. CORCORAN AWARD will be awarded to the highest combined CW and phone score for a YLRL member within an ARRL district. The highest combined CW and phone score from North and Central America will receive a YLAP Hager Plaque (YLRL member only). Another YLAP Hager Plaque will be awarded to the highest combined score from any other part of the world from a YLRL member.

LOGS:

No logs will be returned. Entries in logs must show time, band, date, transmitter power and must be signed. Remember to send separate logs for CW and phone contests. Show claimed score and please check logs. Make sure they have QSO numbers, power and show ARRL section or country to qualify for awards. All logs must be postmarked not later than November 24, 1975, and be received no later than December 19, 1975. Mail logs to: Mrs. Myrtle Cunningham WA6ISY, 1105 E. Acacia Avenue, El Segundo CA 90245.

MANITOBA QSO PARTY

Starts: 0001 GMT Sunday, October 19
Ends: 0300 GMT Monday, October 20

The second Manitoba QSO Party is sponsored by the Amateur Radio Clubs of Manitoba. The same station may be worked on each band and mode. VE4 to VE4 contacts are permitted. Two meter simplex contacts are also permitted.

EXCHANGE:

QSO Number, RS(T), Name & QTH.

SCORING:

Each contact counts 1 point. VE4s multiply the number of contacts by the number of USA states, VE provinces, and DX countries worked. All others multiply the number of contacts made by the number of Manitoba cities and towns worked.

FREQUENCIES:

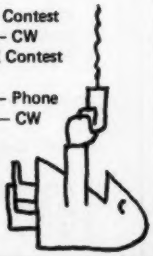
SSB – 3770, 3905, 7195, 7230, 14190, 14285, 21245, 21355, 28600.
CW – 3705, 7105, 14065, 21205, 28205.

AWARDS:

Certificates for the highest scoring station in each province, state and DX country. Plaques for the highest scoring VE4 station and out of province station. Additional plaques will be supplied if warranted.

CONTEST CALENDAR

Oct 1 – Nov 30	RTTY ART Contest *
Oct 4 – 5	California QSO Party *
Oct 4 – 5	Rocky Mountain QSO Party *
Oct 4 – 5	VK/ZL/Oceania – Phone
Oct 4 – 5	CARTG RTTY SS
Oct 11 – 12	CD Party – Phone
Oct 11 – 12	VK/ZL/Oceania – CW
Oct 15 – 16	YL Anniversary Party – CW
Oct 18 – 19	CD Party – CW
Oct 19 – 20	Manitoba QSO Party
Oct 25 – 26	CQ WW DX Phone Contest
Nov 1 – 3	North Carolina QSO Party
Nov 6 – 7	YL Anniversary Party – Phone
Nov 7 – 10	IARS/CHC/FHC/SWL-CHC/HTH QSO Party
Nov 8 – 9	European RTTY DX Contest
Nov 8 – 9	ARRL Sweepstakes – CW
Nov 9	International OK DX Contest
Nov 15 – 16	Missouri QSO Party
Nov 22 – 23	ARRL Sweepstakes – Phone
Nov 29 – 30	CQ WW DX Contest – CW
Dec 6 – 7	160 Meter Contest
Dec 6 – 7	TOPS CW Contest
Dec 13 – 14	10 Meter Contest
Dec 31	Straight Key Night



* = described in previous issue.

LOGS:

Send log data and signed declaration no later than November 10, 1975 to: Doug Bowles VE4QZ, 1104 First Street, Brandon, Manitoba, Canada R7A 2Y4.

Note: Last year only 8 logs were sent in and 4 trophies were awarded. If more activity is not shown this year the contest will be dropped, so send in your logs if you work the contest at all.

NORTH CAROLINA QSO PARTY

Starts: 1900 GMT Saturday, November 1
Ends: 0100 GMT Monday, November 3

All amateurs are invited to participate in the 1975 NC QSO Party sponsored by the Alamance Amateur Radio Club.

EXCHANGE:

NC stations send RS(T) and NC county. All others send RS(T) and state, province or country.

FREQUENCIES:

CW: 3560, 7060, 14060, 21060, 28060.
SSB: 3900, 7270, 14290, 21390, 28590.
NOVICE: 3720, 7120, 21120, 28120.

SCORING:

NC stations count one point for each contact. Final score is total number of contacts times total number of states, provinces and countries. NC mobiles use number of counties operated from for additional multiplier. All others count one point for each NC contact. The same station worked on different band, mode or in different NC county counts as new contact. Final score is total number of contacts times total number of NC counties worked.

AWARDS:

Trophies will be awarded to the highest scoring NC station and out-of-state station. Certificates will be issued to the highest scoring stations in each state, province and foreign country as well as each NC county. A certificate will also be issued to the highest scoring NC mobile station. The NC Counties Award Certificate will be issued to any station participating in the QSO Party whose log verifies his contacting 30 or more NC counties during the Party time period, and has not previously been issued such a certificate by AARC, Inc.

LOGS:

Logs must indicate clearly: signal report, band, mode, GMT, state, province, country or NC county. Logs will not be returned. On a separate sheet, please list the following: your name, callsign and mailing address; your total score; county, state, province, country from which you operated; callsigns of operators. Logs should be signed and mailed no later than December 12, 1975 to Alamance Amateur Radio Club, Inc., 2822 Westchester Drive, Burlington NC 27215. SASE will be greatly appreciated.

RESULTS OF THE 1975 B.A.R.T.G. RTTY CONTEST

Single Operator (top 8 places of 86):

#	Call	Points	#QSOs	Countries
1	I1PYS	221,998	191	33
2	W3EKT	219,520	200	32
3	KZ5BH	197,100	174	23
4	I5GZS	180,164	152	28
5	I8AA	178,596	177	31
6	CT1EQ	170,180	180	27
7	15WT	169,186	157	29
8	IT9ZWS	156,720	154	25

Multi-Operator Stations (top 3 places of 7):

#	Call	Points	# QSOs	Countries
1	DL0TD	180,310	194	28
2	HA5KBM	148,428	142	29
3	SK5AA	94,072	121	21

Short Wave Listener Section (top 3 places of 10):

#	SWL Call	Name	Points	# QSOs	Countries
1	K1LPS/18	Larry Filby	163,150	155	29
2	DL-SWL	Wolfgang Geller	152,640	148	29
3	I3 13018	R. Giarnello	150,600	151	38

IARS/CHC, FHC, SWL-CHC, HTH QSO PARTY

Starts: 2300 GMT Friday, November 7
Ends: 0000 GMT Monday, November 10

An SASE to K6BX will bring more detailed information. Contest is open to all amateurs and SWLs worldwide. Same station may be worked on each band and mode, SSB and AM are different modes.

EXCHANGE:

QSO Nr., RS(T), name, CHC/FHC Nr., US state and county or similar division. Non-members send "HTH" instead of CHC/FHC nr.

SCORING:

For CHC – 1 point per QSO with other CHCers, 2 points if HTHer, and 1 additional point if YL, B/P, FHC, Novice, CHC-200, Merit or Club station, or if on VHF/UHF. Double above points if QSO is out of own country. For HTH – contacts with other HTHers count 1 point, with CHCers count 3 points. Rest same as above. For SWL – use same as above depending on whether CHC or not.

MULTIPLIERS:

Each different continent, country, ITU zone and US state (counted only once).

FINAL SCORE:

Multiplier times total points is final score. Multi-operator stations divide score by number of operators.

FREQUENCIES (for US and DX as allowed):

CW: 3575, 3710, 7070, 7125, 14075, 21075, 21090, 21140, 28090, 28125.
Phone: 3770, 3775, 3790, 3943, 3960, 7070, 7090, 7210, 7260, 7275, 14320, 14340, 21360, 21440, 28620, 50.1-50.5, 145-147.

AWARDS:

Hundreds of certificates and trophies in all categories and divisions are awarded. An SASE will bring further information. Send all requests and logs to: International Amateur Radio Society K6BX, PO Box 385, Bonita CA 92002. Logs should be mailed within 15 days after the close of the QSO Party.

Continued on page 142

SEVEN UP

ON THE COMPETITION

The Clegg FM-DX has many advantages over competitive 2-meter transceivers. Here's seven reasons why you should look to Clegg's FM-DX before you invest in any FM rig.

1. **FULL** 2-meter coverage from 143.5 to 148.5 . . . includes most MARS frequencies.
2. **CLEAN,** beautiful 35-watts transmitter output . . . enough for good simplex range when you want to escape the repeater crowd.
5. **SIMPLICITY** of operation . . . stability and accuracy of the Clegg synthesizer.
6. **RUGGED** modular construction . . . will outlast most of the lesser quality radios in today's marketplace.
4. **UNPRECEDENTED IMMUNITY** from intermod . . . thanks to a super single-conversion receiver. Forget about those police, taxi cab, and other spurious response problems you may have encountered in the past.
3. **PRECISE** large LED frequency readout . . . just like having a frequency counter.
7. **ACCEPTANCE** . . . tells the gang that you own the very best in a dependable American-made transceiver.

For complete Info, Call Clegg TOLL FREE now... (800) 233-0250. In Pennsylvania, Call COLLECT (717) 299-7221.

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VOLUME
RECEIVE FREQUENCY
SIMPLEX
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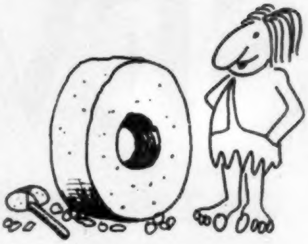
Factory Direct Only

Clegg DIVISION
208 CENTERVILLE ROAD LANCASTER, PA. 17603

NEW PRODUCTS



KLM's ECHO II

Well, the ECHO II has finally arrived! KLM Electronics, long known for its line of VHF log periodic fed antennas and FM power amplifiers, is finally filling the gap left when Gonset quit making the Sidewinder.

The ECHO II, known as the LINER II in Japan, has seen wide use in JA-land. Over 10,000 units have been sold in the past few years there. While one or two other firms have begun making SSB rigs, none are priced as low as the moderately priced ECHO II.

Single sideband has become popular in Japan for several reasons. Their two meter band covers only two megahertz (144-146) and no repeaters are allowed. Many VHF operators hold the special Japanese *no code* ticket which is limited to 10 Watts output. Certainly the narrow bandwidth of SSB helps keep down QRM under these conditions, and sideband greatly extends the useful range of a 10 Watt transmitter as well. SSB consistently gives twice the simplex range of FM, often more!

Aside from the range advantage and smaller occupied bandwidth required, a 3 kHz sideband signal is not affected by multipath distortion nearly as much as FM. I have used both SSB and FM while mobile in the Santa Cruz Mountains and I find that there are numerous areas where FM modulation is completely wiped out by multipath and phase distortion. While sideband shows obvious signs of multipath, the modulation remains "Q-5" in these same locations. In fact, I am able to maintain communication throughout the mountains where FM yields only marginal communication through a repeater located in the same area!

Of course, the Japanese are not the only ones feeling a frequency bind on two meters! Since every repeater in this country takes up at least 30 kHz *even with channel splits*, many areas are really feeling the pinch. In fact, *even with channel splitting* the typical repeater takes up *45 kHz*, since each also requires a UHF control link. *That's nearly as much spectrum for one FM repeater as the entire bandpass required for Oscar 7!* Eight sideband stations could get lost in that much space, and ten could easily fit.

I think that the ECHO II has come along at just the right moment. It's time we start to think about conservation of the two meter spectrum. With the extended range offered by SSB, repeaters are not required for most point-to-point communications. For mobiles, a sideband repeater is not beyond the possibilities and *could* give even better range than FM repeaters, if the performance of the Oscar satellites is any example!

I've used the ECHO II for more than a year. I've derived a great deal of pleasure from the little machine.

KLM ELECTRONICS
POWER
N.B
TEST

I've heard Los Angeles on several occasions (320 miles), worked Sacramento twice (125 miles), and regularly work most active stations within a 60 mile radius in spite of the mountains. I've worked mobiles as far as 60 miles and I've heard high powered mobiles (140 Watts) as far as 125 miles. My best mobile-to-mobile contact has been Watsonville to San Jose, some 43 miles! I've done this with both the barefoot 10 Watt rig and easily with the 140 Watt linear.

ECHO II Specs

Sensitivity: 0.5 uV/10 dB (0.18 uV typical)*
Selectivity: 2.4 kHz @ –6 dB
Frequency: 145.0–145.23 & 145.77–146.0 MHz supplied
Output Power: 10 Watts PEP
Audio Output: 2.5 Watts
AGC: 1 uV–1,000 uV/15 dB af (0.1 uV-1,000 uV modified)
ALC: 3 dB rf change with 13 dB audio change above the level giving 5 Watts PEP
Features: Squelch, VXO, RIT, "S"/RFO meter, ALC, AGC, CW (semi break-in), noise blanker, all solid state
Power Req'd: 11 16 V dc @ 3 A (transmit)
Size: 2.5 x 8.5 x 9.75 inches
Price: $399.00. $499.00 with 70 Watt linear and 9 element antenna. $579.00 with 140 W linear and 14 element antenna. (Omni-directional horizontal polarity mobile antenna available soon.)
**Measured with Singer 6201 Generator and HP 331 Distortion Analyzer. Typical value of three units the author has tested for other people.*

The ECHO II has the following features: AGC, ALC, VXO, RIT, squelch, noise blanker, "Crystal-Plexed" synthesizer, "S"/RFO meter, semi break-in CW, and an external speaker jack.

I have found the 10 kHz channel steps to be a valuable aid when mobile. It eliminates the need to look at the dial to change frequency. If you know where you are in the band, just count 10 kHz for each step until you get where you want to be!

Setting up skeds on a given frequency is simplified, too. Since the 10 kHz steps vary no more than 100 Hz from channel to channel, accurate monitoring of an agreed on frequency is assured.

The VXO allows ±5 kHz deviation from the center of each channel while the RIT varies *only* the receiver to allow fine tuning off frequency stations (±1.5 kHz). This latter feature is especially appreciated during roundtable QSOs.

I find the squelch invaluable to my type of operation. I like to monitor our local calling frequency while going about my other business, but I don't like to listen to receiver noise while doing so. With the ECHO II, I just squelch it up and forget it until someone calls!

The noise blanker is helpful, too. FM, of course, features built-in limiting, not a feature of SSB. However, the ECHO II's noise blanker, in conjunction with its squelch, gives much the same effect. Though FM is better (at least, quieter) with strong signals, SSB certainly has it beat when signals are weak!

This particular noise blanker is quite effective considering its simplicity. It takes the ignition noise of my VW bus completely out of the picture. Its only drawback, common to simple blankers, is a tendency to crossmod when strong, nearby signals are present. Turning the blanker off cures this, of course.

The AGC works quite well above the 1 uV level. It is not very effective below 0.5 uV, however. This can be annoying when working both weak DX signals and strong locals. My solution was to add an extra PNP complementary amplifier in the AGC i-f circuit. Now my unit compresses 0.1-1,000 uV into less than 12 dB of audio change. I can send details to anyone interested who sends me a self-addressed stamped envelope.

I've had opportunity at work to put the ECHO II through its paces on an HP spectrum analyzer. Third order distortion products are about 20 dB below each tone of a two-tone test signal (-26 dB according to ARRL standards). In using the unit with the KLM 10-140BL amplifier, I like to drop the power back to 8 WPEP, and at this level the ECHO II shows only -26 dB third order products (-32 dB ARRL). I did not check the 10-140.

Spurious output and harmonics are all better than 55 dB down. Most are better than 60 dB.

ALC is very effective. A 13 dB change in audio input above the level that gives 5 Watts PEP is compressed to an rf output change of only 3 dB. This keeps the average modulation up where it belongs.

Finally, the ECHO II is *the* rig for the experimenter. As I mentioned, I modified the AGC to be more to my liking. I've also added lower sideband for reception of Oscar 7, AM carrier insertion, sidetone and an rf gain control. My current project is a low noise preamp (under 2 dB).

Other projects could be an upconverter from 10 meters to make the ECHO a self-contained Oscar station, transverters to other bands (such as 220 MHz where that noise blanker would really help!), or an external vfo. I've made numerous Oscar contacts with the unit, so I'm sure the first project is practical. I'm working on the second one and the third should be easy.

There is plenty of room to work in the ECHO II. Unlike older two meter rigs (especially the Sidewinder), this unit is *not* built from the inside out. Everything is readily accessible on PC boards.

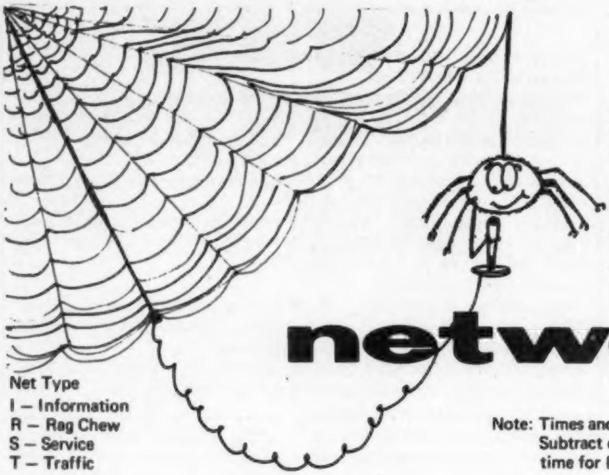
Two meter sideband is flourishing throughout the rest of the ham world. In the US it is just now beginning to get started in a big way. Unlike FM, which received a huge boost when surplus commercial rigs hit the market at ridiculously low prices, SSB is having to make it on its own merits. But when stations in San Jose and Santa Cruz consistently work stations 320 miles down the mountainous length of California *without repeaters*, that gives some of us plenty of incentive to get going! The other opportunities include long-haul tropo, increased mobile simplex distance, and just the fun of roundtables over 60-80 mile paths with no QRM. For the more daring, there is Moonbounce. For the operator with a sense of adventure, there is Oscar. The ECHO II is a great way to start!

. . . James Eagleson WB6JNN/6
118 Sunnyside Ave
Santa Cruz CA 95062

MORE New Products on page 146

E. H. Barnett WB0IIX
Route 1
Ashland, Missouri 65010

You can only get out of amateur radio what you are willing to give. Check into a net. You will make new friends who will be there when you need them! (Ever tried to raise a tower by yourself??) If you don't want to wait for a long roll call, most nets have a "Short Timer's" check-in before roll call. If you do check into a net, tell me about it so I can include it here.



networks

Net Type
I – Information
R – Rag Chew
S – Service
T – Traffic

Note: Times and Days are given in GMT.
Subtract one hour for nets changing
time for Daylight Savings Time.

Service Area	*Net Type*	*Name*	*Time*	*Days*	*Freq*	*Mode*
NATIONWIDE						
U.S.	I	DX Broadcast	0300	Thurs.	14265	USB
U.S.	S	County Hunters	1500	Sat.	14335	USB
U.S.	T	Coast Guard Net	1700	Mon-Fri	14313	USB
Canada	T	Trans Canada Net	1800	Sat.	14130	USB
REGIONAL						
U.S.	T	75M Interstate SBN	0100	Daily	3985	LSB
South Central U.S.	T	7290 Net	1800	Mon-Fri	7290	LSB
W1	T	First Regional Daytime	2100	Daily	3930	LSB
W3	T	Third Regional Daytime	2115	Daily	3195	LSB
W2	T	Second Regional Daytime	2130	Daily	3930	LSB
W4	T	Fourth Regional Daytime	2200	Mon-Wed-Fri	7233	LSB
STATEWIDE						
NY	T	New York RTTY Net	0030	Daily	3613	FSK
W MASS	T	West Mass. Emergency Net	1230	Sun.	3935	LSB
CONN	S	Connecticut Phone Net	1500	Sun.	3965	LSB
VT	T	Vermont SBN	2200	Mon-Sat	3909	LSB
MAINE	S	Sea Gull Net	2200	Mon-Sat	3940	LSB
NY	T	N.Y. City-Long Island Phone Net	2230	Daily	3928	LSB
NY	T	N.Y. State Phone Traffic & Emergency Net	2300	Daily	3925	LSB
NH	T	Granite State Net	2300	Sun.	3945	LSB
CONN	S	Connecticut Phone Net	2300	Mon-Sat	3965	LSB
RI	T	Rhode Island Slow	2330	Wed-Sun	3715	CW

* *

A 90 year old lady wandered from a nursing home in Sterling, Ill. on the afternoon of July 12, 1975. At 5:30 pm, the Whiteside County Civil Defense Director, Kenneth Murphy, put out the call for all available RACES members to respond with communications equipment to help in the search for the elderly lady.

Under the direction of WA9NXE and K9ZIL, coordination with the county sheriff and ILL SP was set up. Groups equipped with portable 2 meter radios were sent out on foot to cover all vacant lots, wooded areas, cornfields and several used car lots in the area next to the nursing home. A steady drizzle of rain didn't hinder the search operations. As darkness closed in, the search was halted at 9 pm with the elderly lady still missing – as the temperature dropped to 50 degrees with rain.

The search resumed again the next morning at 8 am. The same areas were again covered by volunteers on foot with portable 2 meter radios. At approximately 11 am, the long awaited signal was flashed over the 2 meter network by K9APD that the little old lady had been found and her condition was A-OK – but send an ambulance. The little old lady had wandered into a tall cornfield, found a grassy area and, apparently confused and lost, bedded down for the night.

Those who assisted WA9NXE and K9ZIL were K9BEF, K9HOJ, WB9MCZ, K9SFU, K9APD, W9CSP, WA9BSO, WB9DNA and WA9ARR. The Sterling repeater WR9AER also assisted in the rescue.

. . . Whiteside County IL RACES

MORE LETTERS

RE-SHOOTING THE SATELLABE

I have received several letters in reference to my article in June entitled, "Shoot Oscar with a Satellabe". Practically all letters end with, "Where did you get the polar projection map of the northern hemisphere?" I would like to inform the readers that I also had difficulties in finding such a map of needed dimensions. I finally found one in Callbook's "Ham Atlas" that was just the right size. I simply traced it on a piece of mylar and used it for the satellabe.

Due to some misregistration of the multiple "burns" of Figs. 3 and 4, the satellite track does not originate at the equator, where it should, but starts at about 5° northern latitude. This fact makes tables, describing the instantenous position of the satellite, about 1.5 minutes off. Readers should take this under consideration if they want to check the claimed accuracy of the device. Fig. 5 is also slightly misregistered.

K. J. Deskur K2ZRO

Sorry about the misregistration, and thanks again for a great article — Ed.

INFLATION HZ

Everyone knows inflation is bad. I never knew exactly what caused inflation, but my buddy Casey Jones (or should that be KiloHz Jones) says it's a vicious Hz, like a cat chasing its tail, ya know.

I've always wanted one of those solid state transceivers that run on 12 V no-Hz power (dc to you non-Hz'ians). I decided that, if I put my gas guzzler up for a dozen lunar Hz and got one of those little cars with a 2 Hz engine and re-Hz'd some paper and beer cans, I might save enough to get some new gear.

As I started out the door to hop on my motor Hz, I tripped over the jr op's triHz and fell on my face. That really Hz like HI! My motorHz wouldn't start, so I got the XYL's biHz, but both tires were flat.

So I had to call "Hz-Renta-BiHz" (they don't try as hard as that other outfit). I buzzed down and picked up the little gem xcvr and took it home, hooked it to the no-Hz supply and tuned across the many Hz. Down on 29 MHz, I heard a weak sig with plenty 60 Hz on it signing HZ1HZ. I called and called but N.D. I had forgotten the sunspot Hz was at its lowest spot.

Well, u can't win 'em all.

Russell Robinson W4UD
Bristol TN

Our staff holds varied opinions about what prompted this missive. — Ed.

KAHANER'S CLIQUE

Really enjoyed WB2NEL's article on TTLs. Looking for more of the same in the future, I hope.

Dale Sewell WB4JHQ
Pensacola FL

I found Larry Kahaner's (WB2NEL) article very helpful. Please have him write another. I'm especially curious about op amps.

Fred M. Haas W6TXE
Los Angeles CA

I would request urgently that you keep up this talk on ICs and repeat, repeat — I have much difficulty understanding.

Jim Sullivan W1PSW
Woburn MA

I read the article by Larry Kahaner WB2NEL about *How Gates Work — A TTL Primer.* I found it very interesting and hope to see more of the same. Many thanks.

Jim Finnell W6DEU
San Jose CA

We liked your July issue very much — especially the article on page 113 by WB2NEL regarding *How Gates Work.* This is just what I was looking for. Keep up the good work.

Tommy Thompson W6BPV
Santa Cruz CA

Just a quick note between jobs. Great article by Larry Kahaner in July issue (*How Gates Work*). Please talk him into another basic primer on ICs!!

Great magazine, 73!! Keep up the good work. You're far better than the competition!

Jim Washburn WA4FQB
Raleigh NC

RECEPTIONAL OBJECTIVITY

Considering the functional incremental concept of the August issue, coupled with the optional third generation flexibility of its editorial style, I wanted to express my balanced reciprocal capability and say that the integrated transitional options of the issue were outstanding! Editorially speaking I can truly say that you have successfully maximized my receptional objectivity.

John Portune WB6ZCT
Hawthorne CA

Good going, John . . . I'd been betting that not one reader would notice the total meaninglessness of the cover sub-headlines . . . and you caught my little joke . . . Wayne.

COUNT SERBO-CROAT AS TWO

Would you please print the following in the International Intelligence and Correspondence Section of your world-famous magazine?

DL1CU's new edition of "Ham's Interpreter" (just received), which now includes Esperanto, may be purchased from: "Korner, 7016 Gerlingen/Württ., Postfach 9, West Germany."

The price is 5.00 DM and airmail postage is 2.70 DM. Mein Deutschmark Maschine as of today — August 15 — thirty nine cents U.S. per Mark out prints. That means $3.00, or thirty cents a language — twenty seven cents each if you count Serbo-Croat as two. An idiomatic bargain.

Muchisimas gracias to SM7COS, WA1NIZ and WA6ZKI for help in pinning down the above QRA.

While you're printing things — how about more of that good stuff by WB5IRY and K8BFH/1 in the August issue? Thanks much.

Ken Cole W7IDF
Vashon WA

P.S. Perhaps I should mention that all this is in reference to an article in the June issue on page 17.

OVERWHELMED

I note with dismay your reference to a possibility that 73 may change its size sometime. I notice from my complete set of issues that, since its inception, 73 has had one size change (minor) and a change in binding style:

from the stapled edge to the glued edge, which now prevails.

What I have to say is this: If you feel you *have* to copy *QST*, please wait until the end of the year to do it. It will be bad enough having to re-arrange my shelves to accommodate the new size binders. If and when the new size arrives, I hope it will have the stapled binding like *BYTE* has. I see *no* advantage to the glued binding as on *QST*, *PopTronics*, *Radio Electronics*, *73*, etc. (I'll just bet it might be a bit cheaper!)

The first issue of *BYTE* honestly overwhelmed me. I was really expecting a 25-50 pager more like a newsletter. I sincerely hope that issue #1 is just the beginning of better things to come.

Ralph O. Irish WA8GDT
Utica MI

If only QST were going to the large size we would probably stay in our present size, but with the other three changing this means that most of the advertising will be made up in the large size. It is very costly for advertisers to have to design both large and small ads, so the small size would be a serious disadvantage. BYTE *was started out in the large size because most of the advertisers in that field have their ads made up in the large size. Glad you enjoyed* BYTE *– the reaction has been most enthusiastic. We will probably have to go to what is called perfect binding with* BYTE *– this is the style used for* 73 *– no staple to keep the magazine from opening flat as is used by* QST. *The saddle stitching is nice, but doesn't work well for thicker magazines without special machinery which few printers have – this is the style used by* HR *and* CQ. BYTE *will probably be going to 160 pages soon and this means perfect binding . . . Wayne.*

TRACKING THE HAMBURGLAR

Just a note to you on the list of stolen gear in your latest issue of 73 magazine. Of all the gear listed in the stolen gear column, only the last piece is listed in the FBI NCIC computer. This is the gear that was stolen in Billings, Montana. I feel that you should advise your readers that when gear is stolen they should notify their local police department and supply all model and serial numbers. Request the police to enter this data into the FBI NCIC computer. By doing this, if the gear is recovered by another police department, a quick check through the NCIC will reveal that it is stolen and which police department entered this data.

I'm a ham and also a police officer in the communications section of the Lebanon Police Department, Lebanon, Pa. While reading the 73 magazine I was curious if this data was in the computer. I used our CRT terminal and questioned the NCIC on all the gear listed. Only the last set of gear was in the computer. I thought that you and your readers might be interested.

Ptlmn. Eugene D. Mavretic K3UOX
Lebanon PA

LETTERING SECRET

A lot of home brew projects have been popping up. What surprises me is the lettering on face panels. All of them look professional. The best I can do is a label maker. Can you tell me their secret? Is there an easier way than having it engraved for $25.00 to $30.00?

Harry R. Clement
5804 S.W. 12th
Des Moines IA 50315

WHO'S SANE?

Being one of three known non-ham readers of your rag, I frequently feel like a person visiting in the home of a large but nutty family. Nice people but hard to take in groups of more than one. It is fascinating to follow your opinions of the A.A.A.R.R.L.L., the I.R.S.S., that Walker person and all the nice C.B. freaks. To your credit, you publish a mixture of manure that would fertilize the mind of even the most devout member of the stay-in-a-rut and re-build the twenty-third version of a fifteen transistor BFO type experimenter.

Since by now you are wondering if I propose to make a point or will continue to waste my valuable time, let me assure you that I have just such an intention. Because people in general are basically nosy and are apt to be more so about things that interest them, I believe that the time has come for a feature that depicts Peterborough, N.H., the ultra offices of 73 and, perhaps, some of the saner happy people who bring us our favorite magazine. While all these things are commonplace to you, they represent the outer, exotic fringes of man's quest for the meaning of life to those of us who will never be cast upon your figurative shores. (That one lost me, too. Ibid cir. Frst.)

A final point is that such a series of photos would be a CHEAP feature and anyone who ever had to look at a family album knows that some pretty rotten stuff will still interest those who care. In closing, please send your check for this fantastic idea to:

D. E. Stanfield
3408 Catalina Dr.
Atlanta GA 30341

Fantastic idea – so good that I had already thought of it on my own, no mean accomplishment. Naturally, I have reluctantly had to give the surprisingly large check for this brilliant idea to myself . . . too bad. Put on your thinking cap and try again . . . Wayne.

HOBBY WITHIN A HOBBY

Well, after nearly 5 years as *73* "Lifer #306" (30 Jul 1970), I'd have to call myself a satisfied customer. So, I'm willing to try another of your ventures. I wish you luck and hope *BYTE*, which relates to my hobby within a hobby within a hobby (amateur [radio < data processing > teletype] radio), will be as informative as *73 Mag* has been for me.

Ralph Irish WA8GDT
Utica MI 48087

FEARLED AGAIN

Many of your readers have been getting their DX cards back because of an error in our mailing address. Can you please inform them that the "Far East AUX RADIO LEAGUE" address is: FEARL QSL Bureau, c/o Sam Fleming, GARH-ID-GS-T, APO San Francisco CA 96343.

Thank you for this service.

E. M. Fischer KA2NA/W7IOR
NAF Box 67-44
Atsugi, Japan
FPO Seattle 98767

FATTER, TOO!

Enclosed please find the order form from the August issue and a check for $18.95 for the 5-6-13-20 tape package and one of your Advanced study guides. I've been reading and hearing so many good things about your tape/study guide combo, that I decided it was time to upgrade from Tech. And if what I've been reading and hearing is true, I'm looking forward to being on the low bands by Christmas!

Also, I would just like to tell you that I think you have a pretty good magazine going. I especially enjoyed the TTL logic article in the August issue and would like to see more articles like it. Maybe WB5IRY can be persuaded to write that follow up article on flip flops, decade counters and the more complex ICs. Maybe even a series of articles! Lastly, how about a low band frequency synthesizer that could be used with a crystal controlled xmtr for the low budget ops?

Anyway, keep up the good work. It's really nice to read a ham magazine that has a reasonable blend of theory and practical application written in a straightforward manner. And the mag seems to keep getting fatter too!! When my subscription expires in December, you can bet you'll get a renewal.

Stephen J. Toth K7PZN
Seattle WA

RIGHT AGAIN

I have purchased a MITS Altair 8800 computer and a lot of peripheral equipment from other similar sources. I'm having a ball so far. Tell Wayne he's right again!

Jim Stitt WA8ONQ
Middletown OH

QUITE A TIME

This summer I had quite an experience with ham radio and my company car.

Late in June I was headed south on Highway 99 about three miles north of Madera. As I passed by a car parked on the shoulder, I thought I saw a woman lying in the ditch. I immediately pulled off on the shoulder and ran back. It turned out to be an attempted suicide. A woman had jumped from the car while her husband was driving. She was badly injured and emotionally unstable. Not knowing how badly she was injured, and being afraid to move her, I ran back to my company car, which is equipped with two meters and an autopatch. I phoned directly to the Highway Patrol and asked for help. In eight minutes I had 4 patrol cars and an ambulance on the scene.

After making the call I went back to assist the woman's husband, who was having quite a time with his wife. Between the two of us we kept her calm until the ambulance could arrive. She was taken directly to the hospital.

Terry Dunham WA6DPY
Fresno CA
(in correspondence with WB6BFK)

VERY HAPPY

I recently subscribed to "73" and I am very happy with the articles. More beginners' (Novices') and antenna articles would be nice, although you do a nice job of mixing the articles – both in selection and difficulty.

I would like to ask you a very special favor. I am ex-KN4ACA and W4QDF, and the bug has bitten again. As a Novice, I constructed a 15 meter beam made from bamboo poles wrapped in tin foil as described in an issue of CQ magazine. In moving, several times to be exact, all of my old magazines were lost. Our library does not have CQ on microfilm, but could get it on intra-library loan if I could isolate the month and year of this article. I know that you were with CQ during this period, and knowing that this is a terrible imposition, I respectfully request that you please examine your index issues for this article. It should be in the range of 1953-1957.

I thank you very much for this. Best of luck with "73". It's a great magazine. I've stopped both QST and CQ.

Billy P. Edward
Chattanooga TN

Try November, 1955, page 11, "$3.96 Beam" . . . Wayne.

FANTASTIC NEWS

Fantastic news in the mail today. Passed the Advanced and Extra Class exams. All thanks to those study guides and code tapes. All in all, a pair of very good study guides, presenting the theory in a fresh light.

The code tape was also a great help. Copied for ½ to one hour each night for about a month or so. Didn't bother to study or copy the last two nights before the exam – just relaxed.

Once again, thanks for taking the time to put out something that really does help those who need it.

Bill Seibt
FPO Seattle

HP-45 FUN

You may be interested in knowing that Tektronix has discovered that the HP-45 has a timer just like the HP-55. It works like this:

1. Press the "RCL" button.
2. Simultaneously press 3 keys: "7", "8", "CHS". If you have a display like this

00	00	00	00
hr	min	sec	1/100sec

you are now in the timer mode (keep trying – part 2 just takes practice).

To operate the timer:

"CHS" key will start or stop the timer running;

"CLX" will reset the timer to zero;

"EEX" – try it: Any number key will store a "split" while timer is running, or recall a "split" to the display when timer is stopped;

"." causes calculator to leave timer mode.

Find an HP-45 and have fun!

Sig Peterson III
Portland OR

GOING MOD . . . 35

Got your mag today, and I want to give you some advice regarding the sprocket feed Teletype that you want.

DO *NOT* BUY A TELETYPE MOD 33 *SPROCKET FEED!*

GET A MOD 35 INSTEAD.

The Teletype mod 32 & 33 are fine pieces of equipment in their friction feed versions, but when used as a sprocket feed they become quite a headache for all concerned. The owner has to put up with frequent outages and pay for the repairs; the technician has to squint and peer to see the workings, and frequently can't even figure out what is wrong in a short time, so, up go the costs again.

In summary, the mod 33 sprocket feed is subject to excessive down time compared to the venerable 33 friction feed. The money would be well spent buying a mod 35 sprocket feed that will just run and run and run and run and run . . .

My experience stems from seven years as a technician for Western Union Teleg. Co. and not as a result of not understanding the 33 sprocket feed machine – it's just that I feel that the design is poor.

Paul Robertson
Rochester NY

Continued on page 152

Bob Hart K7YGP
622 W. 4th St.
Medford OR 97501

Build a Deluxe TTY Keyboard

Part One

The equipment available to an amateur setting up a RTTY station is usually limited to what is available on the surplus market. While a Model 28 ASR would have been ideal, monetary considerations and convenience dictated a more modest choice for the author: a Kleinschmidt Typing Reperf. Since there was no provision to originate data with the Kleinschmidt, it was decided to construct an electronic TTY keyboard (just for fun). This keyboard started out as just a simple TTY generator but grew to include several handy, if not essential, extra functions. These added functions include a character counter (so you know when to insert a Carriage-Return), automatic Carriage-Return (in case you forget), automatic Letters/Figures shift, and a test generator capable of producing either RY or binary sequential Quick Brown Fox. While the keyboard need not be built with these added functions, they do make operating more enjoyable. Besides, it might even impress your friends.

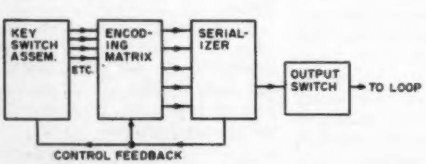


Fig. 1. Simplified block diagram of TTY generator.

The Basic TTY Generator

As with any mechanical keyboard, the function of the TTY generator is to form a seven unit serial code stream at the proper rate, corresponding to a particular symbol, when a key is pressed. The logic used to perform this function is shown in block form in Fig. 1. The key switches connect to an encoder which converts each key closure to a unique parallel binary code. This binary code is then converted, in the next block, to serial form which then drives an output switch. The actual circuitry for the encoder can take several forms but the serializer is easiest to implement as a parallel in/serial out shift register (see Fig. 2).

The seven stage shift register and associated clock and control circuitry are in a standby state when all Q outputs in the shift register are high. This allows the output of U8 to go low which in turn inhibits the clock and forces the output of U9 (output gate) high (Mark). The switches connected to the Reset inputs of each shift register stage, representing the output of an encoder, are closed wherever a Mark signal is required. If, for example, we wish to generate the code for "R," the switches corresponding to the position of Mark pulses in the code stream are closed momentarily. Thus register stages 3, 5 and 7 are reset while the rest remain in the set (Q high) state. The Q outputs of the reset stages are now low causing U8's output to go high. This high signal does two things: The clock is started and the clamp is removed from the output gate which allows the output to go low, initiating the start pulse (Space). If we are generating 60 wpm (45 Baud) TTY, the first pulse is generated by the clock 22 ms after it receives the go signal. This pulse shifts data in the register one stage downward.

At this point the start pulse ends and the first data pulse begins. Every 22 ms the clock generates another pulse and the data in the register is shifted another increment toward the output. The effect of this is that the output gate sequentially samples the state of each register stage for 22 ms and forms the serial TTY code. After seven pulses from the clock, all register stages are once again in the Q high state. The output of U8 goes low, shutting off the clock and clamping the output of U9 high. At this point the circuit is ready to begin another cycle. The circuit is relatively simple and has the added advantage of being self-clearing since any Q low state in the register is automatically shifted out. The only problem

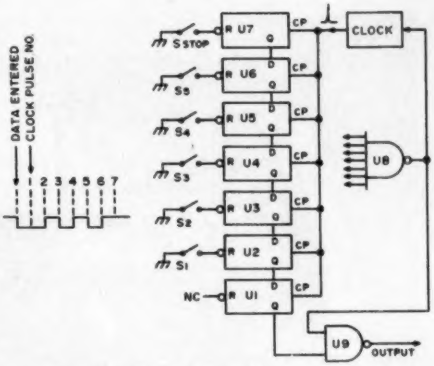
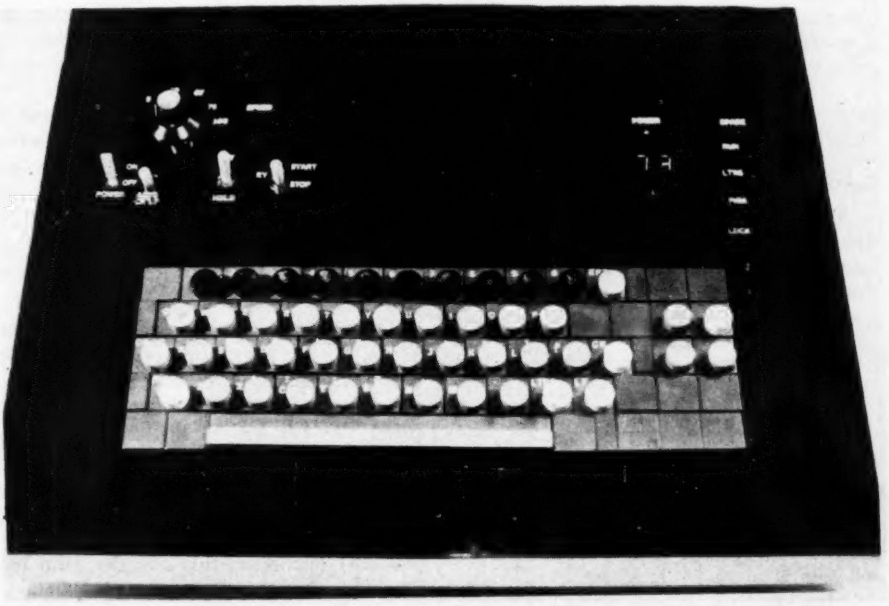
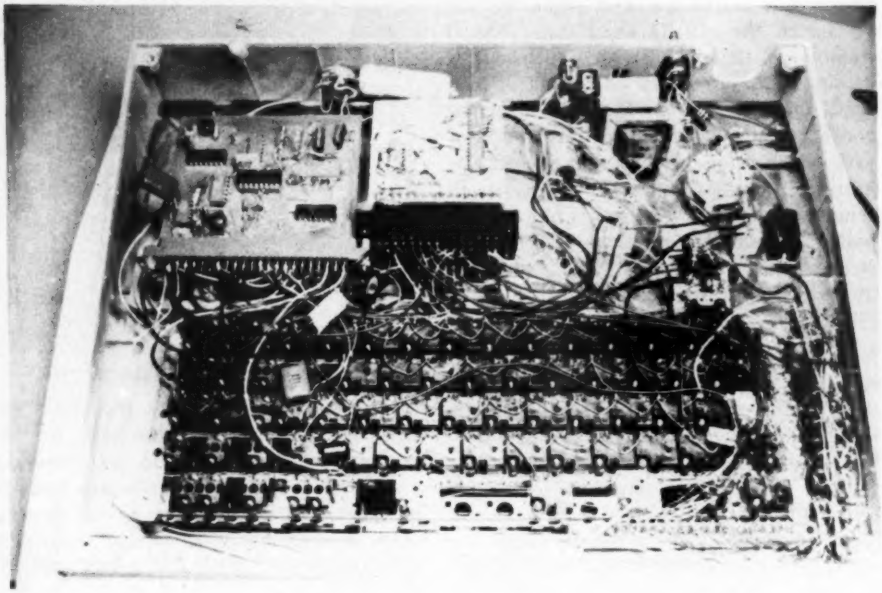


Fig. 2. Shift register and output for "R."



Top view of keyboard. Note character counter display. Column of lettering on right is associated with line of function lights. From top to bottom: Space (neon bulb across loop jack), Run, Ltrs, Figs, Lock. Top of keyboard is smoked plexiglass which needs refinishing. Also note number keys along top, and period and question mark keys. These are auto shift keys, i.e., Figs is sent automatically before the character. Actually the same thing (auto shift) happens when a letter key is pressed, except Ltrs is transmitted first.



Bottom view of keyboard. Matrix on right. Middle circuit board hides 3 others below which contain keyboard logic and test generators. Circuit board on left is Auto Shift – Auto CR/LF.

now remaining is to arrange for a method to close the input switches (trained fleas?).

Encoding Matrices

Knowing the naturally uncooperative nature of fleas, an investigation was begun into electronic methods of encoding the shift register. This diligent research uncovered three types of encoding matrices. They are probably called matrices because of the rectangular form of the encoding device interconnection. Anyway, these methods are the key switch matrix, the diode matrix, and the magnetically coupled (toroid) matrix. A brief description of each will be given in case the builder would like to try a method different from the one the author used.

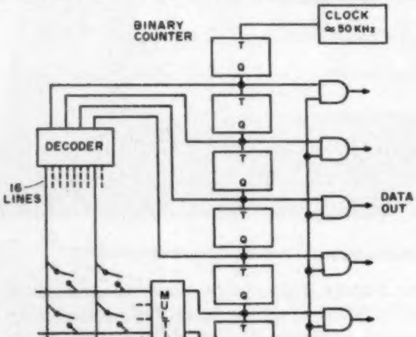


Fig. 3. Key switch matrix.

Of the three matrix methods mentioned above, the key switch matrix is conceptually the most complex but because of integrated circuit logic probably the simplest to construct. As shown in Fig. 3 the system consists of a six stage binary counter, a 1 of 16 decoder, a 4 to 1 multiplexer, a high frequency clock, and several gates. While only five code bits are necessary for TTY (Baudot) encoding, this encoder (and the others) includes an extra bit for Figures/Letters information used to drive auto-shift circuitry. In this particular encoder, the clock continuously drives the counter through all possible code combinations but without a key closure there is no output. With a key closure, there will appear a pulse at the output of the multiplexer that is coincident with a counter state that corresponds to the coding of the desired character. (Did you get that?) Thus the output gates are enabled only when the counter is at the proper state. This system should work well and is used quite often commercially but was not used in this project since some of the necessary ICs were unavailable.

The second system, the diode matrix, is fairly self-explanatory. A key switch is connected to each appropriate register stage through isolating diodes. Disadvantages of this system are the large quantity of diodes required and the space required for those diodes.

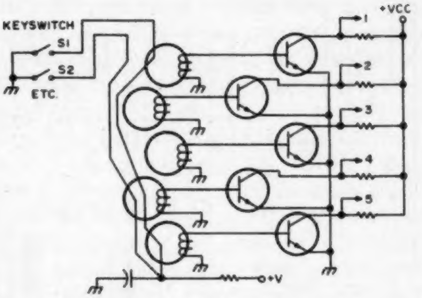

KEYSWITCH
S1
S2
ETC.
+VCC
1
2
3
4
5
+V

Fig. 4. Magnetically coupled (toroid) matrix. Closing S_1 generates a pulse at outputs 1, 4 and 5. Closing S_2 generates a pulse at output 4.

The last system, the magnetically coupled matrix (Fig. 4) is actually much simpler than the name indicates. So from here on it will be known as the toroid matrix even though that isn't an exact description. This system uses a small toroid transformer for each bit output. The secondary of each transformer is connected to a transistor which acts like a normally off switch. The primary consists of a series of wires passed through the toroids from a charged capacitor on one end to a key switch on the other. There is one primary wire per key switch and since only one switch is closed at a time there is excellent isolation between the primaries. When a switch is closed, a pulse of current flows through the wire, inducing a voltage on the secondary of each transformer the primary wire passes through. These pulses turn on the associated switching transistors which in turn deliver reset pulses to the appropriate shift register stages. This system rates first in compactness and economy and

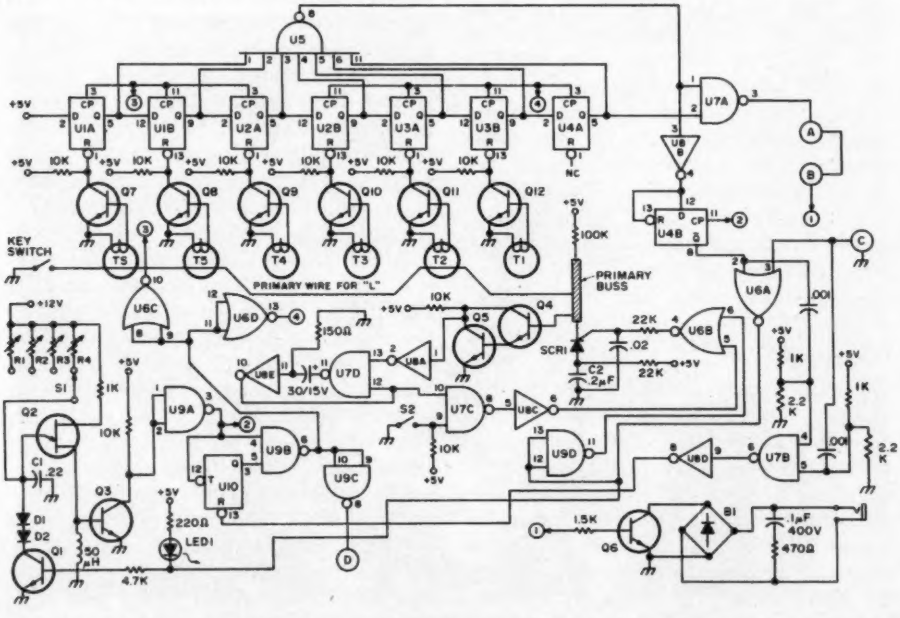

U5
+5V
U1A
U1B
U2A
U2B
U3A
U3B
U4A
CP
D
Q
R
NC
10K
Q7
Q8
Q9
Q10
Q11
Q12
T5
T4
T3
T2
T1
KEY SWITCH
PRIMARY WIRE FOR "L"
100K
PRIMARY BUSS
U7A
U8B
U4B
U6A
U6B
U6C
U6D
U7B
U7C
U7D
U8A
U8C
U8D
U8E
U9A
U9B
U9C
U9D
U10
T
A
B
C
D
+12V
R1
R2
R3
R4
S1
S2
Q1
Q2
Q3
Q4
Q5
Q6
1K
C1
.22
D1
D2
50 µH
4.7K
220Ω
LED1
150Ω
30/15V
22K
.02
SCR1
C2
.2µF
2.2K
.001
1.5K
B1
.1µF
400V
470Ω

Fig. 5. Basic keyboard schematic — all ICs. Vcc connects to pin 14, ground to pin 7. Lettered terminals connect to auto function generator.

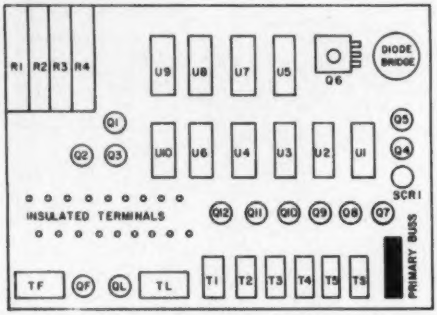


Fig. 6. Possible component layout.

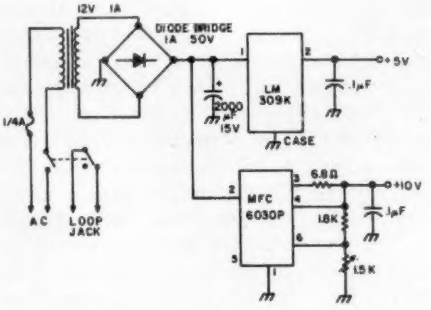


Fig. 7. Keyboard power supply.

for those reasons was included in the TTY generator.

Putting it Together: The Basic Keyboard

Now that both major sections of the TTY generator have been described, all that remains is to interface the two to each other and to the outside world (a 60 mA or whatever loop). None of the extra features are included since none are needed for generating a TTY signal. Any or all special features can be added later at the builder's option.

Because of its wide availability and low cost, 7400 series SSI is used for most of the circuitry of this project. No doubt, the circuit could be re-designed using MSI TTL or CMOS for lower package count or lower power consumption but that's for the next model. Referring to Fig. 5, the circuit consists of ten ICs, six matrix toroids, and several switching transistors. The keyboard will generate all TTY codes, including Blank, at switch selected speeds of 60, 67, 75 and 100 wpm. The stop pulse is 1.5 units long, which compares closely with the "standard" of 1.4 units.

Operation

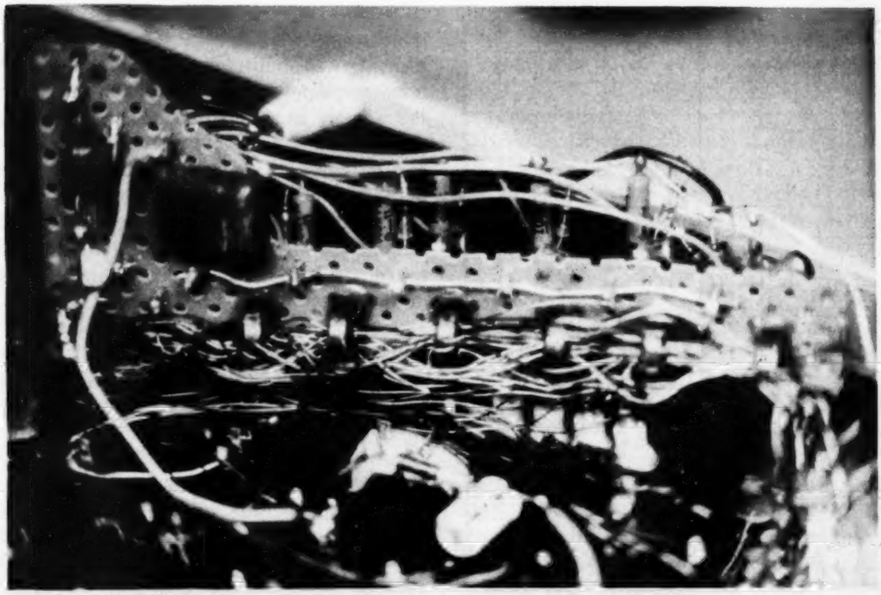
For purposes of explanation, the circuit is assumed to be in the standby state: The Qs of all stages of the shift register are high, no key switches are pressed, and the clock is off. Since the Qs of all shift register stages are high, the output of U5 is low forcing the output of U7A high. This drives Q6 into saturation keeping the loop closed through the diode bridge. The bridge, by the way, permits the keyboard to interface with the loop without regard to polarity. The low signal from U5 is also inverted and applied to the Reset and D inputs of U4B. The $\overline{Q}$ output of U4B is therefore low, having been previously toggled by the last clock pulse of the last operation cycle. This low is inverted by U6A and applied to Q_1 which saturates and clamps the clock off. The output of U6A is also inverted by U9D (the signal is now low, in case you lost track) and applied to one input of U6B. The other input is high at this time so the output to U6B is low. The run indicator, LED_1, is off at this time.

Now we make something happen. A key switch is depressed and held. Any key would do, but for this example we'll press "L." The primary wire passing through T_s, T_5, and T_2 is grounded bringing the primary buss to ground. There is no output from the matrix at this time since the 100k biasing resistor provides insufficient current and the gate of SCR_1 is held low by the output of U6B. What does happen is that the darlington pair (Q_4,Q_5) stops conducting and its output goes high causing the output of U8A to go low. This triggers the single character one-shot (U7D and U8E) whose output goes low for approximately 1 ms. The low at the input of U7C gives a low at the output of U8C. This results in low signals at both inputs to U6B causing its output to go high, triggering the SCR. This discharges the .2 uF capacitor through the primary wire. Finally, coding pulses are generated from matrix toroids T_s, T_5, and T_2. These set the Q outputs of U1A, U1B, and U3A low. Since any low input to a NAND gate results in a high output, the output of U5 goes high. U7A is now permitted to invert the output of the shift register (which is now high) and initiate the start pulse (the output switch, Q_6, opens). The high from U5 is also inverted and applied to the Reset of U4B. $\overline{Q}$ goes high, the output of U6A goes low, and Q_1 stops conducting permitting the clock to start. At the same time the output of U6B goes low, dropping the gate voltage of the SCR to below firing level. The SCR stops conducting when the .2 uF capacitor discharges since the 22k charging resistor supplies a current below the holding level of the SCR. The .2 uF capacitor now begins to charge. The busy indicator, LED_1, is now on.

The clock, which was started in the previous paragraph, includes Q_2, a UJT relaxation pulse generator, Q_3 and U9A (2 F buffer), U10 and U9B (1 F generator), and U6C, U6D, and U9C (1 F buffers). The pulse generator operates at twice the register shift frequency; at 60 wpm the clock produces a pulse every 11 ms. Positive going pulses at the double frequency are available from the output of U9A (2 F) and positive going pulses at the shift frequency (1 F) are present at the outputs of U6C, U6D and U9C. The outputs of U6C&D drive the shift register while U9C drives external circuitry.

Assuming we are generating a character at 60 wpm, the first shift register clocking pulse occurs 22 ms after the clock is turned on. Data in the shift register is shifted toward the output gate as has been previously described. After the seventh clock pulse, the register is cleared of all Q low data and the output of U5 goes low. This once again clamps the output of the output gate in the high (Mark) condition. The inverted output of U5 (high) is applied to the D input of U4B. Eleven ms later, the next 2 F clock pulse causes $\overline{Q}$ of U4B to go low, stopping the clock and returning the keyboard to the standby mode. The action of U4B therefore extends the seventh or stop pulse 50% longer than the other pulses in the character. The stop pulse can, of course, be longer (it depends on how fast you type) but this limits the minimum length and guarantees a 7.5 unit code.

During the time the clock is running (the run indicator is on) and a TTY character is being generated, no additional data can be



A view of the toroid matrix. All those wires running through it give the appearance of a mess, but it works. The primary buss, SCR, and C2 are located on the left side.

entered into the register because of the low signal at the gate of the SCR. To send another character, the original key must be released and then another (or the same) pressed. This will fire the U7D-U8E one-shot and permit the generation of another character. Thus only one character is generated for each key closure. If the repeat key (S_2) is closed along with a character key, the keyboard will continually reprogram and transmit that character. Note that all the repeat key does is defeat the single character one-shot.

			CORE					
KEY	LTRS	FIGS	STOP	1	2	3	4	5
A	•		•	•	•			
–		•						
B	•		•	•			•	•
?		•						
C	•		•		•	•	•	
:		•						
D	•		•	•			•	
$		•						
E	•		•	•				
3		•						
F	•		•	•		•	•	
!		•						
G	•		•		•		•	•
&		•						
H	•		•			•		•
#		•						
I	•		•		•	•		
8		•						
J	•		•	•	•		•	
'		•						
K	•		•	•	•	•	•	
(		•						
L	•		•		•			•
)		•						
M	•		•			•	•	•
.		•						
N	•		•			•	•	
,		•						
O	•		•				•	•
9		•						
P	•		•		•	•		•
0		•						
Q	•		•	•	•	•		•
1		•						
R	•		•		•		•	
4		•						
S	•		•	•		•		
BELL		•						
T	•		•					•
5		•						
U	•		•	•	•	•		
7		•						
V	•		•		•	•	•	•
;		•						
W	•		•	•	•			•
2		•						
X	•		•	•		•	•	•
/		•						
Y	•		•	•		•		•
6		•						
Z	•		•	•				•
"		•						
BLANK			•					
SPACE			•			•		
C.R.			•				•	
L.F.			•		•			
FIGS			•	•	•		•	•
LTRS			•	•	•	•	•	•

Fig. 8. Toroid matrix wiring. Where a dot appears, the primary wire passes through that core.

You may notice that there are a few extra components that seem to perform no function, such as U6A, U7B, U8D and U9C. These components are used to interface with the auto function generator to be described later. With a little re-design, those gates could be eliminated if you have no desire to include the automatic functions. That re-design would save one IC package.

Power Supply

Two supply voltages are required for the ITY keyboard: +5 V and +10 V. Both sources must be regulated for good frequency stability and proper operation of the logic. The easiest (and one of the best) way to do this is to use IC regulators. One power supply that works is shown in Fig. 7. About .5 A at 5 V and 25 mA at 10 V will supply the fully optioned keyboard. The second section of the line power switch is used to short the loop jack when the keyboard is turned off. Otherwise, the loop would run open when power is removed from the keyboard.

About Construction

Being a prototype, this circuit was not built using printed circuit techniques, but instead was built on a combination of breadboarding cards and perf-board. For those who would like to build this on a circuit card, a suggested layout is shown in Fig. 6. Notice that all the matrix toroids are on a common axis with the primary buss. With about 1/2" (12 mm) between toroid centers, threading of the primary wires is not too difficult and the matrix takes up little room.

Fig. 8 is the wiring chart for the matrix primaries. Where a dot appears on the chart, the wire passes through that particular toroid. The two extra cores listed on the chart are used to drive the auto Figs/Ltrs circuitry and can be excluded. In order not to duplicate wiring in the matrix if it is planned to include auto Figs/Ltrs (auto shift), all primaries that will involve an upper case key are connected to a separate terminal after passing through the shift register toroids (T_S&T_1–T_5). From there, one wire will pass through the Ltrs core and to the designated lower case key switch. Another wire will connect to the terminal and pass through the Figs core and to the designated upper case key switch. For example: Both "U" and "7" have the same coding. A primary wire is connected to the primary buss and passed through T_1, T_2, T_3, and T_5. The primary wire is there attached to a terminal. One wire from the terminal passes through the Ltrs core to the "U" key switch and another wire (from the same terminal) passes through the Figs core to the "7" key switch. Only about fifteen primary wires need be treated this way: ten numerals and commonly used punctuation.

One additional thing about the toroid matrix: The polarity of the output pulse of the transformers is dependent on winding direction. Therefore all transformers must be wound as shown in Fig. 9.

The Great Keyboard Controversy

The major factor preventing the construction of any type of electronic keyboard has usually been the unavailability of an acceptable key switch assembly. To get around the problem, several previous keyboard articles have described home made switch assemblies. Well, as far as the author is concerned, home made keyboards don't work well. The problems of pretravel, post travel, and actuating pressure are often more than the home constructor can cope with. Fortunately, the price of commercial keyboards has fallen to a fairly low level on the surplus market. The keyboard used for the prototype has been available without a case from Tri-Tek for $11.50. Others are available from Meshna and B and F Enterprises for prices up to $50. These prices are quite reasonable when you consider that enough microswitches to construct a keyboard (at least 30) would cost about $12 surplus. And then you have to build the thing!

Will It Really Work?

After you have gathered the pieces for this project, figured out where to put all of them, and wired them together (don't forget to check for errors), there comes a time when you have to turn it on. Before you do, collect a few pieces of test equipment: a counter, a Teletype machine of some sort, and a logic probe. The counter is not essential but it makes setting of the clock a little quicker. A typing reperf would be ideal for checking the output, but a page printer will do. And if you don't have, can't find, or won't build a logic probe, a dc 'scope or a VOM will do pretty much the same job of tracing down bugs in the logic (but not as handily).

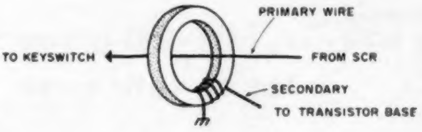


Fig. 9. Transformer winding.

Now you can turn it on. Check for proper supply voltages and smoke. If everything appears OK and you have a counter, the clock rates can be set. Connect the counter to theoutput of U9A and ground the base of Q_1. Adjust R_1 for 91 Hz, R_2 for 100 Hz, R_3 for 113 Hz, and R_4 for 148 Hz. Remove the jumper at Q_1 and the clock should stop. Press a character key and the clock should run momentarily (the run light will blink). Press a character key and the repeat key, and the clock should run continuously. If these things do not happen, get out your logic probe and find out why before continuing. (If you have no counter, do everything in this paragraph except adjust the clock – you get to do that later.)

Now the keyboard can be connected to the typing reperf through a 60 mA loop or any other way you want to do it. If the clock was not previously timed, now is the time to give it a try. Turn the keyboard on with the speed selector (S_1) at the same speed as the reperf. If your reperf has four speed capability you will be able to calibrate all four speeds. If not, calibrate what you can (or want). At the moment, the loop should be closed. If not there may be a problem with the output switch. If there is no problem, press the "T" switch. The reperf should do *something*. Adjust the appropriate speed adjust pot and again press the "T" switch. Continue this process until the reperf prints "T." You will find that the machine prints correctly over a small range of speed adjustment. Set the speed pot in the middle of this range. If there is difficulty in getting the machine to print "T" there may be a problem with the shift register or the encoding matrix. This is the difficulty of adjusting the clock without the aid of a counter. The technique requires that the rest of the keyboard operate properly.

If you have managed to calibrate the speeds properly all that remains is to check the coding of the rest of the characters on the keyboard. Any errors in coding will probably show up as consistently superfluous or missing pulses. These can be traced to a malfunctioning shift register stage or a particular matrix toroid. While there are undoubtedly other places in the keyboard where problems can arise, it should be fairly easy to trace them down by following the circuit description.

Next Time

The circuit described above is a simple, reliable, and not too expensive substitute for the mechanical TTY keyboard. Its ability to generate near perfect coding at any speed makes the electronic keyboard a valuable addition even if you already have a complete TTY setup. While the keyboard can be used as is, the inclusion of the automatic features makes its operation even more enjoyable. The concluding part of this article will describe those features and their operation.

Parts List

R1 – 60 wpm –20k var. + 47k
R2 – 67 wpm –20k var. + 33k
R3 – 75 wpm –20k var. + 33k
R4 – 100 wpm –20k var. + 22k
S2 – Closed for Repeat
T1 – Ts – Toroid Core – 1/4" I.D.
SEC – 10 turn No. 28 Enam., PRI – No. 28 Enam. (see text)
Q1, Q3 – Q5, Q7 – Q12 – NPN
Switching Transistor 2N2222 or = (HEP-55)
U1 – U4 – 7474
U5 – 7430
U6 – 7402
U7, U9 – 7400
U8 – 7404
U10 – 74107 (or 7473 or 7472 with different pinout)
C1 – .22 uF, 50 V mylar
D1 – D2 – Silicon diode 1N914 or =
B1 – Silicon Bridge Rectifier – 400 piv – 100 mA
Q6 – MJE-340 (HEP-244)
SCR1 – 2N889 (HEP–R1001)
Q2 – 2N493 (HEP-310)

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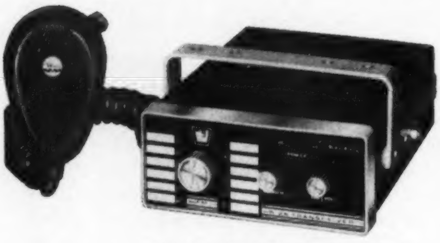

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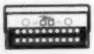

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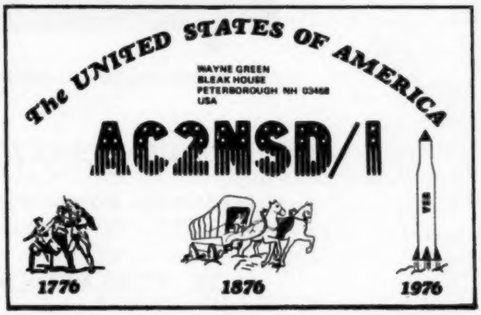

You also get your own name and address on the card (unless you happen to be another Wayne Green, which happens).

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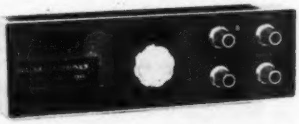

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Op Amps: Basic Primer

Operational amplifiers, or op amps, are high gain dc amplifiers. And I do mean high gain! Amplifications are on the order of 30,000 to 1,000,000, depending upon internal design and circuitry.

Op amps have two great advantages over discrete components. Economically, they represent about 1/4 to 1/2 the cost of individual components needed for a similar circuit. Secondly, they are physically more convenient for amplification of small inputs.

Within the two major tribes of IC products, op amps are linear. This means that the output is directly and proportionately related to the input. This is in contrast to digital devices which do not always obey this rule. There are, however, some applications in which we want them to operate non-linearly, such as flip flops and comparators. We can make any op amp act non-linear by exceeding its rated values.

The Innards

Op amps are usually monolithic. That is, they are made on only one piece (or chip) of silicon. By imbedding metal oxides on this silicon base we can make transistors, resistors and capacitors without the wasted space of cases and coverings. Thus, we can have many transistor amplifiers added together yielding tremendous gains. One op amp may be the equivalent of four or more amplifier circuits.

Sometimes, field effect transistors (FET) and junction field effect transistors (JFET) are made. So, if you never knew what MOSFET was, now you know. It stands for Metal-Oxide-Silicon Field Effect Transistor.

A Differential Amplifier

The symbol for the op amp is shown in Fig. 1.

The op amp is a "differential amplifier". It acts by amplifying the *difference* of the inputs only. If we impressed the same signal on each input at the same time, the two amplified output signals would be 180° out of phase and cancel.

If we feed a signal at the Non-Invert input (+) and ground the Invert input (–), our output will be in phase with the input. A signal impressed on the Invert input while the Non-Invert is grounded will be out of

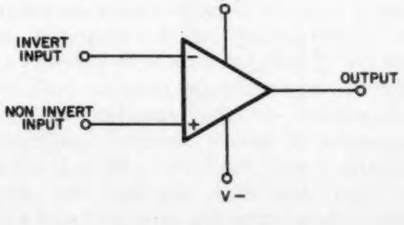

Fig. 1. Operational amplifier.

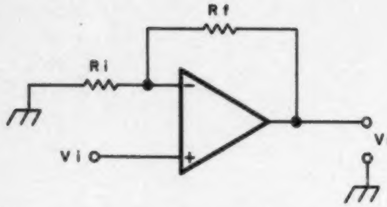

Fig. 2. Non-inverting amplifier.

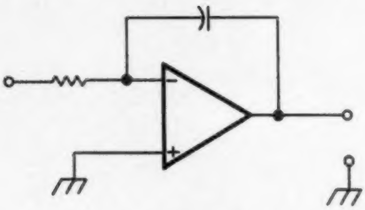

Fig. 3. Integrator.

phase when it is amplified.

The power supplies, V+ and V−, are separate entities. We need a + supply and a − supply, usually 15 volts or less. To only supply + 15 and then ground the negative will not give the proper potential. Batteries are often used.

A Few Basic Circuits

The most important and most used application of op amps is of course as amplifiers. Fig. 2 shows a typical amplifier.

It is called a *non-inverting amplifier* because the output is in phase with the input. Employing negative feedback (the feedback circuitry goes to the − input), it is the backbone of more complex amplifiers.

As with any amplifier, we have gain. The choice of input and output resistors (Ri and Rf) determines our gain. We try to come as close to our ideal gain while keeping other needs and special criteria in mind. This is similar to a tube situation where we try to come as near as we can to mu.

The next two circuits are opposite in purpose and design. They are the *integrator* and the *differentiator*. The *integrator* shown in Fig. 3 has a capacitor in the feedback circuit and a resistor in the input. It takes the sum total of the input signal over a specified time.

If we had a weird input as in Fig. 4 and we wanted to know the total voltage from time a to b, the integrator could do this for us. Mathematicians call this integration and use the symbol $\int$ to show it. In geometry we find the area under the curve by doing the integration of the equation of that waveform. It can be thought of as adding together a great number of individual shapes so thin and close together that they approximate rectangles. And we know how to find the area of rectangles quite easily.

The integrator does this adding technique for voltages, and is the basis of the analog computer.

The *differentiator* shown in Fig. 5 is just the opposite. It has a capacitor in the input and a resistor as its feedback component. Instead of adding the input signal it will respond to each and every change of the input. Since the capacitor will not pass dc, only discrete changes (ac) will be seen at the output. It is useful in instruments for obtaining the rate of change of voltages.

Remember the cathode follower from your license exam? In the IC world we have the *unity gain buffer*, also known as the

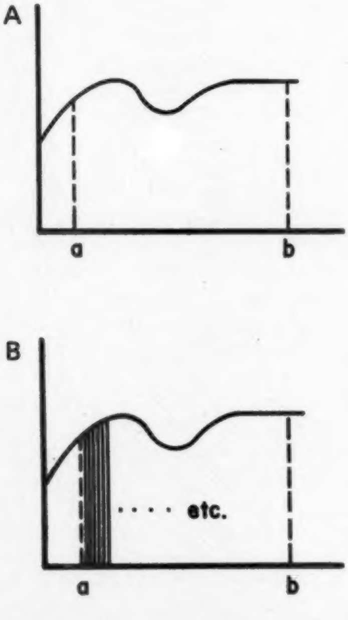

Fig. 4. (a) Weird waveform. (b) Weird waveform with rectangles.

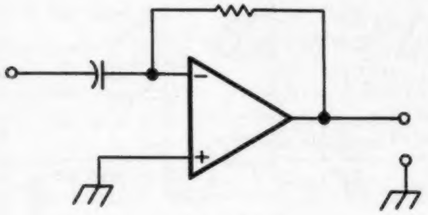

Fig. 5. Differentiator.

voltage follower. It has a gain of 1 and is used as an impedance matcher. High input impedance and low output impedance make it an excellent buffer between stages.

Compensations

As in other very precise and sophisticated devices, op amps must be compensated for many variables, external and internal.

Frequency Compensation

Op amps have difficulties at high frequencies. At these frequencies they do not amplify all inputs equally and thus there is a decrease in gain. This decrease can cause phase shifts due to time delays. The answer is to use a large capacitor in the circuit. Many op amps are internally compensated for this high frequency loss. They already have a capacitor within the chip. Some have provisions for external compensation. This information is in the specs.

Output Offset Voltage Compensation

In an ideal negative feedback circuit, the output is zero when our input is zero. But nothing is ideal. Very often there is a large (relatively speaking) dc output which can adversely affect performance. Due to slight mismatches in internal circuitry and design, we have two unwanted inputs which cause this unwanted voltage.

The first of these unwanted inputs is the Input Bias Current. As said before, op amps are a myriad of transistors. These semiconductors must be biased to conduct. No matter how well we try to match these biasing currents they will never be equal.

The difference of these currents passing through the resistors in Fig. 2 causes a voltage which will be amplified. In order to reduce this problem we add a resistor to the Non-Invert input. This new resistor reduces the input voltage because now the *difference* of the bias currents flowing in the op amp is made less than *either* of the bias currents. They have become negligible variables. (Remember, only input *differences* are amplified.)

Our next unwanted input is due to intrinsic chip characteristics. This Input Offset Voltage is usually small enough for most applications, but if it is not, we make use of the "Offset Null" tabs of the IC. By placing an external potentiometer across these terminals we can null our voltage to exactly zero.

Other Parameters

Other variables and factors are worth mentioning. They are seen in most specs and are *not* self-explanatory.

The first is *slew rate.* This is the maximum rate of change the output can negotiate. The slew rate is *always* given in spec charts and can be used to compute switching time needed between maximum output levels of our specific circuit. It is important in switching applications where

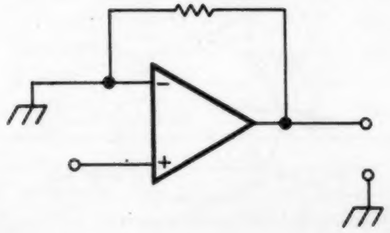

Fig. 6. Unity gain buffer or voltage follower.

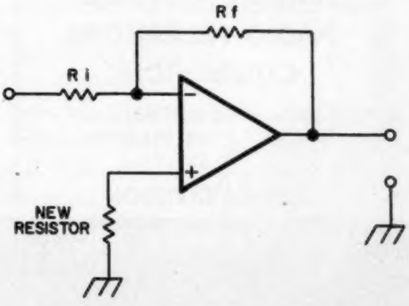

Fig. 7. Compensating resistor added.

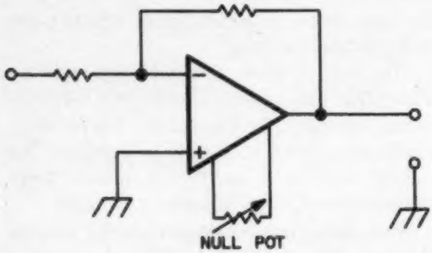

Fig. 8. Offset null potentiometer added.

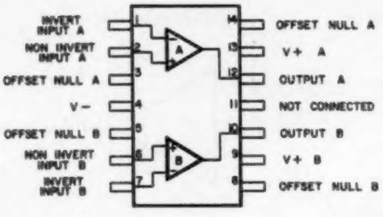
INVERT INPUT A
NON INVERT INPUT A
OFFSET NULL A
V−
OFFSET NULL B
NON INVERT INPUT B
INVERT INPUT B
OFFSET NULL A
V+ A
OUTPUT A
NOT CONNECTED
OUTPUT B
V+ B
OFFSET NULL B
A
B

Fig. 9. 747 op amp. The 747 is internally compensated for frequency.

we must be careful not to design our output time to be faster than the op amp can handle.

The second is called the *common mode rejection ratio (CMRR).* Remember that the op amp responds only to differences of input. We would like it to reject all similarities in inputs but we settle for what we can get. This CMRR is a measure of how well the op amp rejects common inputs. Measurements are in dB, and the higher the better.

And thirdly, like all semiconductors, saturation can be a problem. *Latch up* is the aspect of op amps to stay at saturation, either + or –, after their maximum differential voltage has been reached. At this point the op amp will not behave linearly.

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The 741 op amp is an example of a device which has lessened this problem by incorporating a very high input voltage rating.

What They Look Like

Op amps come in two shapes, DIP and TO. DIP means Dual-In-Line Pins and is the rectangular or square chip with parallel terminals on opposite sides.

TO stands for Transistor Outline, and is so named because it is in the shape of a transistor. You will often see a "5" after the TO. This is a unit of size and is needed for heat sink and space criteria applications. Most op amps are TO-5.

The Inside View

The top view of a 747 op amp would look like Fig. 9 if we X-rayed it. The shape is DIP.

The 747 is internally compensated for frequency.

The 748 chip is a TO-5 package and has provision for external frequency compensation (see Fig. 10).

. . .WB2NEL

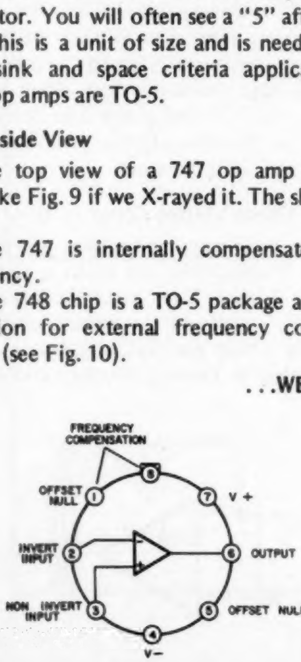
FREQUENCY COMPENSATION
OFFSET NULL
INVERT INPUT
NON INVERT INPUT
V+
OUTPUT
OFFSET NULL
V−
1
2
3
4
5
6
7
8

Fig. 10. 748 op amp.

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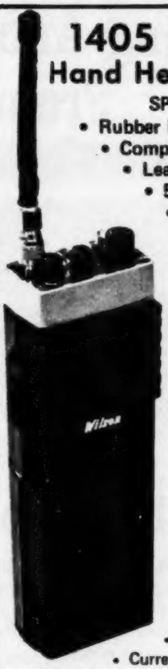

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Basically the HCV-2CS will provide complete slow to fast scan monitoring; fast to slow scan conversion for utilizing a standard CCTV fast scan camera such as the RCA TC1000; interconnection to utilize the standard slow scan camera if desired; complete interconnections to connect the HCV-2CS into the existing or proposed slow scan system; auxiliary fast scan monitor output; tuning meter for sync (1200 Hz) signal tuning as well as LED tuning indicators for proper adjustment of Monitor Black and White Compression levels (1500 Hz and 2300 Hz), when tuning in the SSTV signal from the receiver and adjusting the monitor for proper black and white levels prior to receiving a picture from the receiver; tape recorder input and output jacks; telephone line input/output jack. A built-in viewfinder is provided for set up of a standard fast scan camera.

The slow to fast conversion will be based on a 256 line format displayed on a 9 inch rectangle CRT (cathode ray tube) being deflected at fast scan rates (composite fast scan video will be based on 15,750 Hz, horizontal, 60 Hz vertical field rate – 30 frames per second and a composite video amplitude of 1.4 volts pp being present at the auxiliary fast scan monitor output connector). Brightness of display will be similar to the home TV set or standard fast scan video monitor. In addition 2 basic modes of reception/display will be provided as follows: 1. displayed as being received; 2. freeze display which will allow any picture to be frozen on the screen. The main memory will be a combination of CCD chips and digital shift registers to make up a total memory of some 80,000 bits. For those modifying current HCV-2A(B) monitors the display will be 6.5 inches, but all other functions will be as stated.

The fast scan to slow scan conversion will accept the standard composite fast scan video from a camera or video tape recorder (VTR), which is based on 15,750 Hz horizontal, 60 Hz vertical field and 1.4 volt pp video amplitude signal and convert this composite video to slow scan standards. ¼ and ½ frame rates, black-white (positive-negative) color reversal and a 4 shade vertical gray scale generator will aslo be provided in this section. Also a special feature to convert a frozen fast scan picture back to slow scan so that it may be retransmitted as slow scan will also be provided in this section. This feature allows picture that is being retransmitted to be reprocessed, before or during retransmission, if needed.

Front panel of the HCV-2CS will have all necessary controls for all modes of operation such as brightness and contrast for the fast scan monitor section; black and white compression controls for slow to fast and fast to slow converters; video/voice switch; slow scan and fast scan video selectors – Camera – Receiver – Tape; slow scan and fast scan video display selection; SS-FS RT switch for converting a frozen fast scan picture back to slow scan for retransmission; freeze switch. A total of 16 front panel controls to control all functions, in addition to tuning meter for sync tuning and LED indicators for black and white frequency, 1500 Hz and 2300 Hz, will be provided. Fast scan horizontal hold to be located on rear panel along with fast scan monitor video level control.

The HCV-2CS will measure approximately 14"W x 15½"D x 8½"H. All circuitry to be on gold flashed, glass epoxy, plug in printed circuit boards with ICs, Op Amps, transistors in plug in sockets. All of the system will be fan cooled via of ultra quite fan mounted on rear panel.

Current delivery projection is scheduled for around September 30, 1975. Price: - $925.00, F.O.B., Hendersonville, Tennessee. The HCV-2CS may also be purchased less the fast to slow scan converter, which could be installed at a later time, for $795.00, F.O.B. Hendersonville, Tn. Conversion kits for the current HCV-2A(B) owners will be available about the same time for around $400.00, or factory installed for $600.00. Write for trade in allowance on HCV-2A(B) monitors stating serial number, date purchased, etc. The RCA TC1000 fast scan CCTV camera complete with lens and power supply is now in stock for $245.00; GBC CTC4000 is available for $225.00 and the JFD 604 with fast scan viewfinder built in is $495.00 complete with F1.9-22 lens. We also have a full line of lenses, tripods, tape recorders (audio and video) and other accessories. 1 year warranty on cameras.

A complete brochure will be prepared shortly and mailed to you with ordering information on the HCV-2CS. To hold the HCV-2CS at the current price a deposit of at least 25% will be required ($231.25 for standard HCV-2CS or $198.75 for the HCV-2CS less fast to slow conversion). Note that the balance would be due prior to shipment of the unit. All prices and specifications are subject to change at our option without notice, except prices that are frozen with a deposit as mentioned above. All rights are reserved by SUMNER. **Write for more detailed specs and reserve yours now.**

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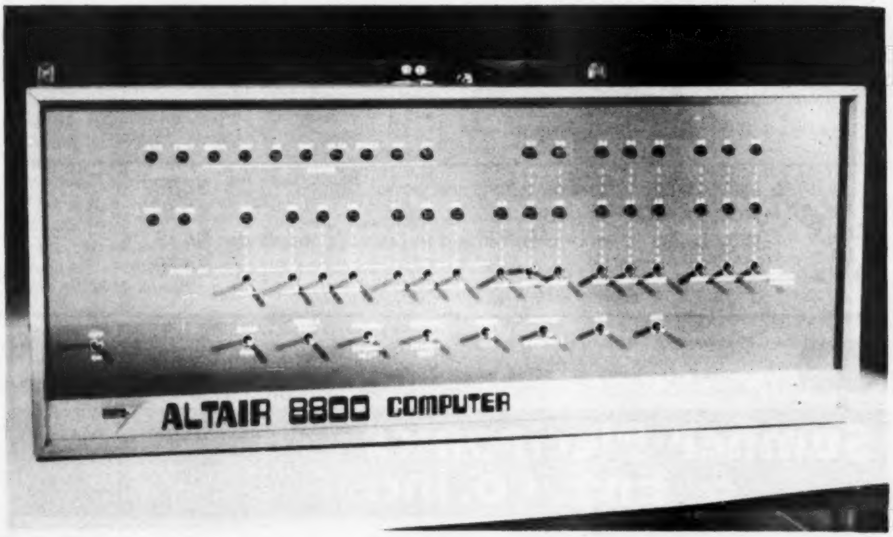
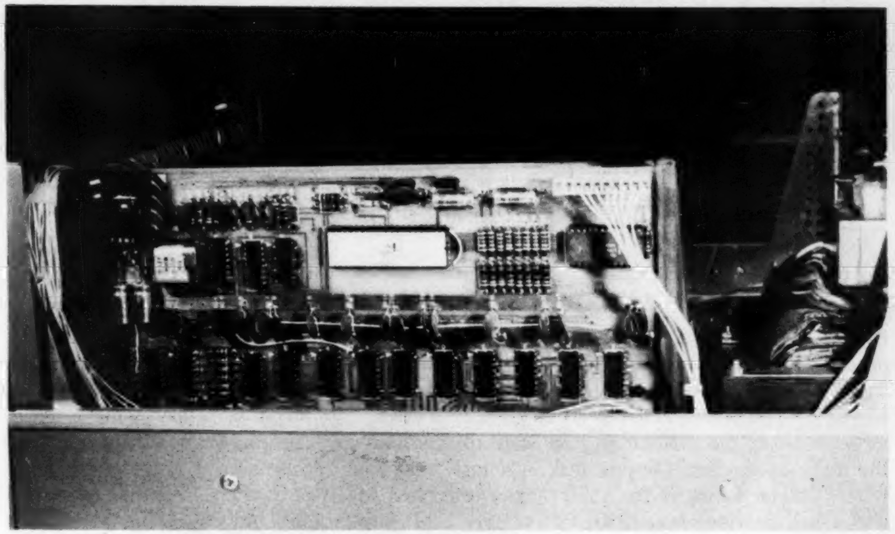
Computers Are Here - Are You Ready?

Like Duz (do they still make Duz?), computers are getting a reputation for being able to do just about everything. It is well earned, for to understand computers is to love them . . . they are being billed as the World's Greatest Toy, and this is not much an exaggeration, young long-haired blonds notwithstanding.

More and more amateurs are tackling the new inexpensive computer kits and coming up with very usable results. Some are using the units to aim their antennas for moon-



The Altair 8800 . . .



and a look inside.

bounce, some to predict or even aim antennas at Oscar, some to operate a virtually automatic RTTY station, some to run a repeater or even a system of repeaters . . . and so forth.

The Three Basics

There are three parts to a computer system . . . the central processing unit, cleverly called a CPU, the gadget which costs the most money and which does most of the work . . . an input/output device such as a teletype . . . and some sort of memory for the CPU to keep things on file when it is not actively working with them.

IC technology has been raising havoc with CPU prices, dropping them in large increments every few months. The latest chips such as the Intel 8008, 8080, National PACE, IMP-16, and Motorola M6800 have spawned a breed of miniature CPU which is so low in cost that it has made the hobby computer a practicality. The first large quantity production of CPUs using the new series of microprocessor chips was put out by MITS in January . . . their Altair 8800. This sold for $439 in kit form and $621 assembled and tested . . . about one tenth the price of previously available minicomputer units.

RGS Electronics and Scelbi Computer Systems had been producing computer kits before this using the Intel 8008 chip, but these were not as well publicized and the 8008 chip has more limitations than the 8080, which is used in the Altair.

More and more CPU kits are becoming available . . . such as the recently announced Godbout system using the National PACE chip . . . this holds a lot of promise for a lot of computer at a ridiculously low price. Another new one is Sphere, available in kit or assembled form in the same basic price range of $500-$600 with enough built-in memory to do some work.

There are two basic forms of memory required . . . one in the CPU to permit it to do its work . . . and one outside for longer term use. The internal memory stores operating program instructions and things retrieved from the larger memory which have to be used by the CPU. Practically speaking, the larger the internal memory of the CPU, the faster your computer system can operate. For instance, if you had a record of all of the stations you've ever contacted in the main memory and you wanted to sort through for one particular call, it would be easier to find if your CPU could grab a thousand stations out at one time and check them against the call you need instead of checking maybe ten at one time. You'd find the record you want one hundred times faster.

But, alas, memory costs money, and a happy medium has to be struck between what you want and what you can afford. You can get along with 4k of memory . . . that's actually 4096 bytes, where a byte is 8 bits of memory, the amount needed to represent a letter or number. Memory costs about 4¢ per byte today, but it will be coming down.

Long term memory units have been coming down in price too, though it is still possible to buy a brand new Ampex 40 Megabyte disk system for $24,000 if you like to pay list price and get into that sort of scene. More in the amateur end are some of the soon to be seen floppy disk systems which will be selling in the $500 range and which will provide about 250k of memory on each disk. The disks are a lot like phonograph records and can be changed quickly.

One of the simplest and least expensive memory systems involves the audio cassette recorder, and many hobbyists seem to be working in this direction. It is a little slow, but it is extremely cheap and you can have a lot of memory that way. The standard for using them is a familiar one, with the two RTTY audio frequency shift tones being used.

SANDERS
720
SANDERS
720
SANDERS
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720

Keyboards from Sanders: Running rampant.

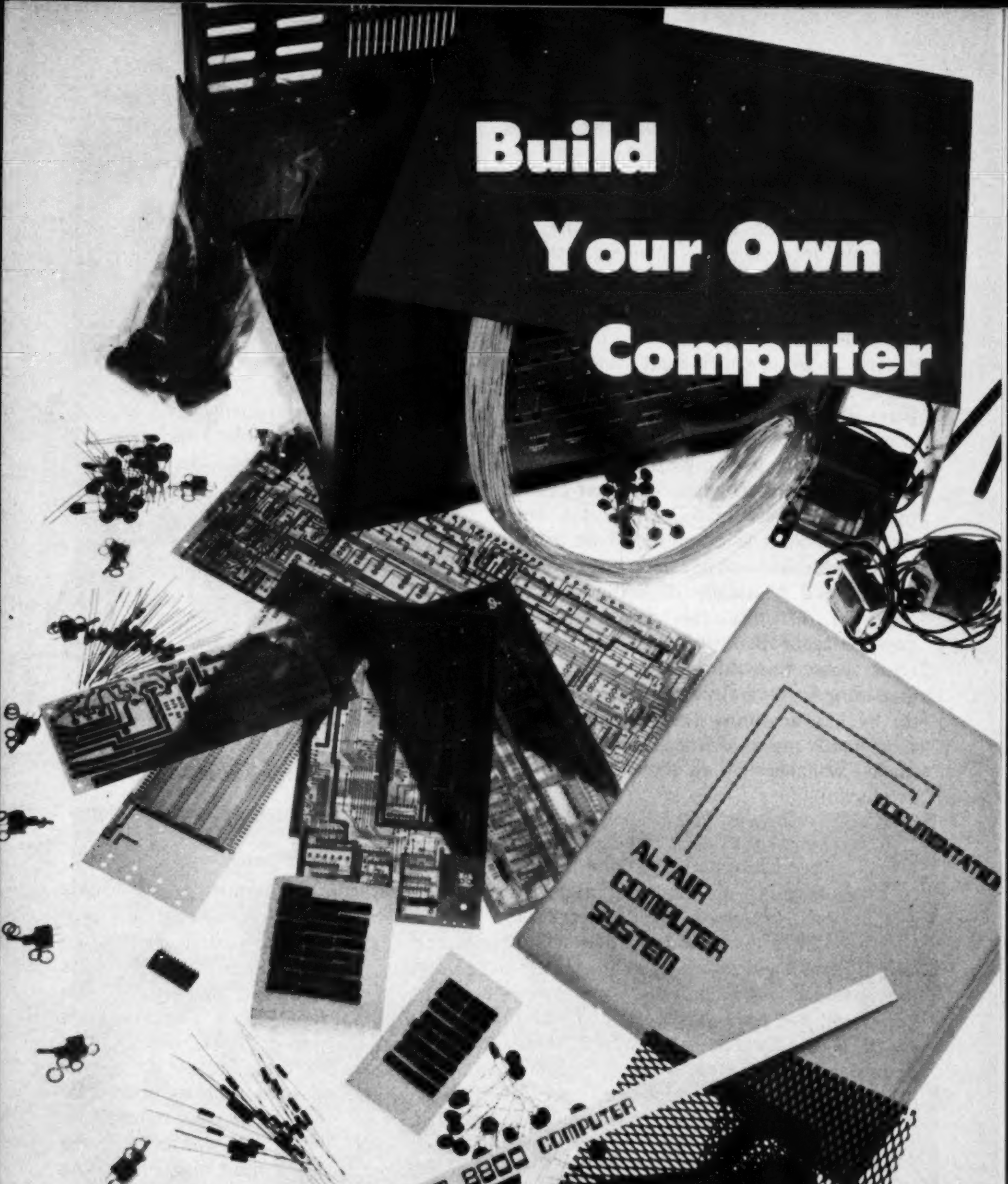
Even the input/output situation is changing rapidly. Of course you can buy an old teletype machine for $50 to $100 and it will work quite well. You might even want to go to a faster and more modern machine, if you can promote one at less than the price of a good used car. The more usual system now is to put together a video display terminal and work from that. These are available in kit form for around $150 to $250 and are a cinch to put together. The Southwest Technical video display generator costs $175 in kit form and can put together by a 12 year old. The keyboard that goes with this one runs another $40 and works like a champ. Or you may want to shop around for a surplus keyboard for the same or a slightly lower price . . . most of them have ASCII output and this is all you need to hook things together for a working system. (American Standard Code for Information Interchange = ASCII.)

Uses

Once you have your CPU, memory and I/O up and working, you then have to decide what you want to do with the system. You may want to use it to keep track of stations you've worked, with little bits of information about them for recall on the video screen (any television set will provide the video part of the terminal for you). You may want to catalog your record collection or your book library . . . or perhaps articles in the ham magazines.

If you are into RTTY you realize that your computer system is the main part of a RTTY station. You can program it to send at 60 words per minute, either from the keyboard or from any material you have in the memory . . . and receive the same way, printing it out (and memorizing the stuff, if you want) on your screen.

Perhaps you prefer CW . . . so program the computer to convert the ASCII letters into appropriate CW characters . . . select the speed you prefer . . . and type away as fast as you like for several hundred words. Your computer can also decipher incoming CW for you and print it on the screen. There probably will be a good deal of 50 wpm CW around in the future as computer-assisted ops work each other.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Your checkbook? No strain, many hobbyists are using their systems for keeping their bank accounts in order.

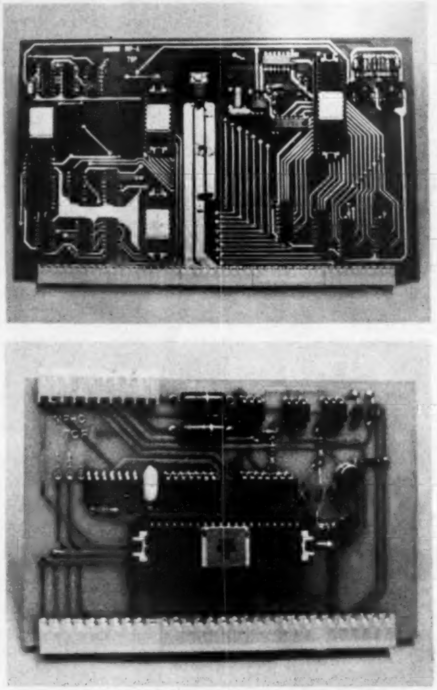
If you have a small business of your own you may want to apply some of the computer power to it . . . inventory . . . accounts receivable . . . mailing lists . . . things like that.

Programming

This is a bit sticky right now, but the situation is improving. One problem has been that there have been a whole lot of computers designed, but not all that many of any one model . . . so the programming work has had to be done over and over to match each new machine that has been developed. And as computers have gotten more and more complicated, programming has followed . . . usually increasing about ten times in difficulty for each increase in complexity of the CPU. Thus, while CPU costs have been dropping rapidly, programming (software) costs have been going up by like amounts. This may improve as more and more identical computers are made available . . . a benefit of mass production.

The problem with programming is that it takes forever to put in instructions when you have to do it one single step at a time. The idea is to enable the computer to translate simple words and instructions into all of the ones and zeroes which the machine requires to do its digital job. These simple yesses and nos are called machine language . . . it is the only language the CPU will understand until you "teach" it (via a program) a more complicated set of instructions, thus enabling it to translate.

The manufacturers of most computers spend a lot of time and money working out the translations (programs) and they are usually reluctant to give these away. MITS has implemented Basic and has it available for about $60 when you buy a 4k memory board. A number of small groups have formed to provide cooperative efforts on developing programming and many of the more popular computer systems have user groups who swap programs.



CPU and Serial Interface boards from Southwest Tech.

Learning About Computers

An unfortunate number of the books which have been published with the purported aim of helping you to learn about computers are just plain terrible. The fact is that the rank newcomer to computers is in for a very difficult time. The magazines (with the exception of BYTE, which sort of resulted from this situation) are written for professionals and have little of interest or value to a beginner. Little is written for the experimenter, the circuit designer, or the programmer . . . with most magazines being devoted to the business end of the computer field.

73 author Pete Stark has written an interesting introduction to computer programming which is scheduled to be reprinted by Tab Books . . . watch for an announcement of that one. The Lancaster TTL Cookbook is fine for hardware fans . . . published by Sams at $8.95.

Adding Two Plus Two

The basic CPU usually comes with a set of switches, one for each of the eight bits which make up each byte of information (each character). One set of LED lights indicates which memory location is open for use and the other set indicates what is in that memory at the time. To machine program such a CPU you flip the "examine" switch and the lights will then indicate what is in the first memory position. You set the switches according to the instructions that tell the CPU what you want it to do. Let's say you want to do something very simple at first like add two numbers. Here's how you'd go about it.

There are eight bits to be put in each memory bin. To save a lot of writing and work these are abbreviated. Written out they would look like this:

00 000 000

If you've read about binary numbers you know that 000 = 0, 001 = 1, 010 = 2, 011 = 3, 100 = 4, 101 = 5, 110 = 6, 111 = 7. Thus, using this notation, a binary number such as 01 011 111 would be written 137. Got it? That's called octal notation (base 8).

The Intel 8080 chip in the MITS Altair 8800 has a bunch of instructions built into it when you get the unit. This tells you that, if you set the first memory to 072, this will instruct the CPU to pick up whatever number you have in a specific part of the memory and put it into a small working memory unit called register A . . . this is all done inside the 8080 chip. When we push the "deposit" switch this puts the 072 into the first memory position. Next we set up the switches for 200 . . . this is the place where we will put the number we want to add. We push the "deposit next" switch and this puts the 200 into the second memory position. After consulting the instructions again we set up 107, which means move what we had in register A to register B. "Deposit next" takes care of that.

Now we pick up the second number . . . the one we want to add to the first. 072 (deposit next) says move to register A the contents of what we say next . . . 201 (deposit next). A 200 instruction tells the chip to add A to B. Then an 062 tells the

A typical test set-up – thorough – at SWT.

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chip to move that sum to whatever location we say next ... we pick 202 and deposit that information. We end the operation by telling the chip to jump back to 000 again and wait for further instructions.

All you have to do to add is put number 1 into location 200, number 2 into location 201 ... push the "run" and then the "stop" switches and turn the switches to read out what is in memory position 202 ... presto: the sum of the two numbers.

Perhaps you can see why machine language is a back breaker and why everyone wants to get programs which will enable them to merely type in something simple like: A = 300, B = 5.3, C = A x B, PRINT C, END, RUN. There are a great many computer languages ... something over 700 in current use ... but a few have come into more popular acceptance such as RPG, Cobol, Basic, Fortran, and such.

The most basic of instructions to the computer are usually put in by means of punched tape or by cassette ... such simple programs as assemblers. This is a lot faster than sitting there flicking bat switches for each of the eight bits to load a program into a couple thousand memory positions ... your fingers and patience would wear out. So would the switches after a while.

If you get into this field you'll find that most of the computer languages are relatively simple ... you just have to sit down for a few days and work with them until you get the hang of the things and learn to correct your mistakes ... and you'll make a lot of them. Programming is difficult only because it is exacting – a computer does not forgive errors, it just compounds them for you. It takes a lot of time and patience to beat new trails ... so it is fortunate that user groups are proliferating to provide exchanges of programs ... why keep on inventing the wheel, right?

I hope I haven't worried you about computers ... they are not very expensive these days ... are getting cheaper ... and are an enormous amount of fun to play with. Get cracking ... and as you conquer new territory, make a chart for the rest of us and send in the information to 73 and BYTE.

...W2NSD/1

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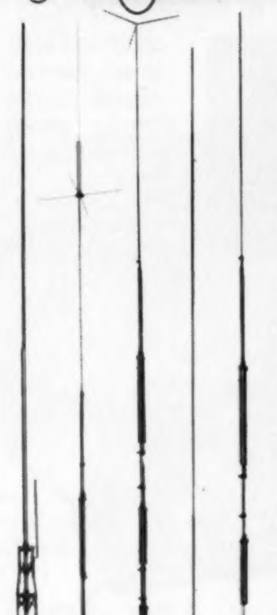

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HIGH
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LOW

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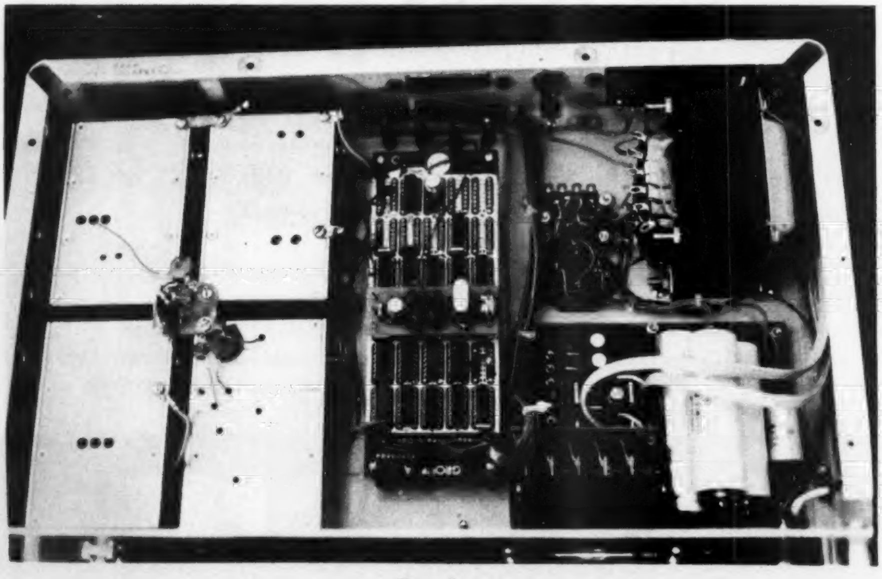
0-60 MHz Synthesizer

Conclusion

The circuitry of the synthesizer is conveniently divisible into the following groups: PLL A, PLL B, PLL C, PLL D, low frequency crystal oscillator, high frequency crystal oscillator, mixer and output amplifier, and power supply.

PLL A

The circuit of PLL A is shown in Fig. 9. FET Q1 forms a voltage controlled oscillator whose frequency is a function of the bias on hyper-abrupt tuning diodes D1 and D2. The oscillator is buffered by A1, and squared for use by ECL by A2 and A3.



Top view.

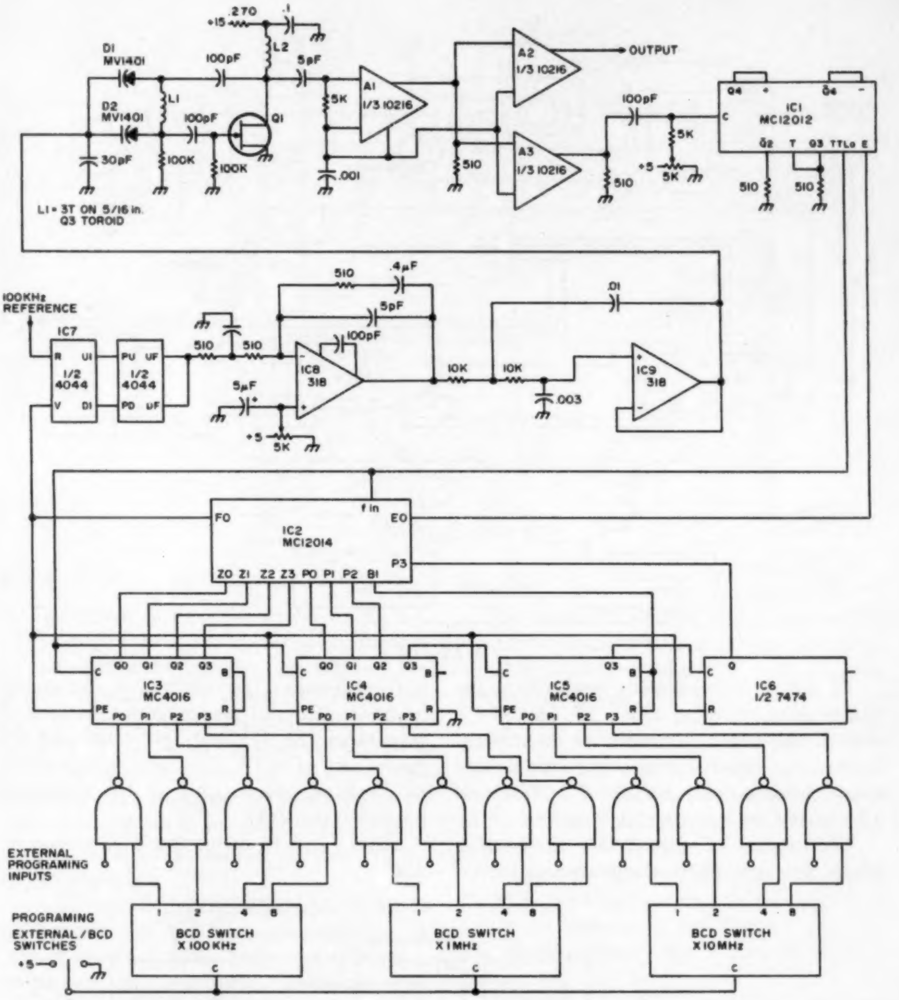

+15
.270
.1
L2
D1
MV1401
100pF
5pF
OUTPUT
A2
1/3 10216
A1
1/3 10216
L1
D2
MV1401
100pF
Q1
5K
100pF
IC1
MC12012
Q4
Q̄4
C
Q̄2
T
Q3
TTLo
E
5K
30pF
100K
100K
.001
510
A3
1/3 10216
+5
5K
510
510
510
L1 = 3T ON 5/16 in.
Q3 TOROID
510
.4μF
.01
5pF
100KHz
REFERENCE
IC7
100pF
R
U1
PU
UF
1/2
4044
1/2
4044
V
D1
PD
UF
510
510
IC8
318
10K
10K
IC9
318
5μF
.003
+5
5K
f in
FO
EO
IC2
MC12014
P3
Z0
Z1
Z2
Z3
P0
P1
P2
B1
C
Q0
Q1
Q2
Q3
B
IC3
MC4016
PE
P0
P1
P2
P3
R
IC4
MC4016
IC5
MC4016
IC6
1/2 7474
Q
EXTERNAL
PROGRAMING
INPUTS
PROGRAMING
EXTERNAL / BCD
SWITCHES
+5
1
2
4
8
BCD SWITCH
X 100 KHz
BCD SWITCH
X 1 MHz
BCD SWITCH
X 10 MHz

Fig. 9. PLL A.

The signal from A3 is capacitively coupled to prescaler IC1, with R1 set to the optimum bias to compensate for slight differences between prescalers. The control logic and 4016 counters form a programmable divider which can be programmed either by the front panel switches or by an external source to divide by any integer between 1000 and 1999.

The output of the programmable divider is fed along with a 100 kHz reference into phase detector IC7. The output of the charge pump is fed into integrator IC8, and then through low pass filter IC9 to reduce sidebands. The loop is closed by connecting the output of the low pass filter to the VCO.

With the component values shown the loop has a response time of about 2 ms and a maximum operating frequency of 180 MHz.

PLL B

The circuit of PLL B is shown in Fig. 10. IC11 is a voltage controlled oscillator with a TTL compatible output. Its frequency range is about 1-3.5 MHz over an input voltage range of 1-4.5 volts.

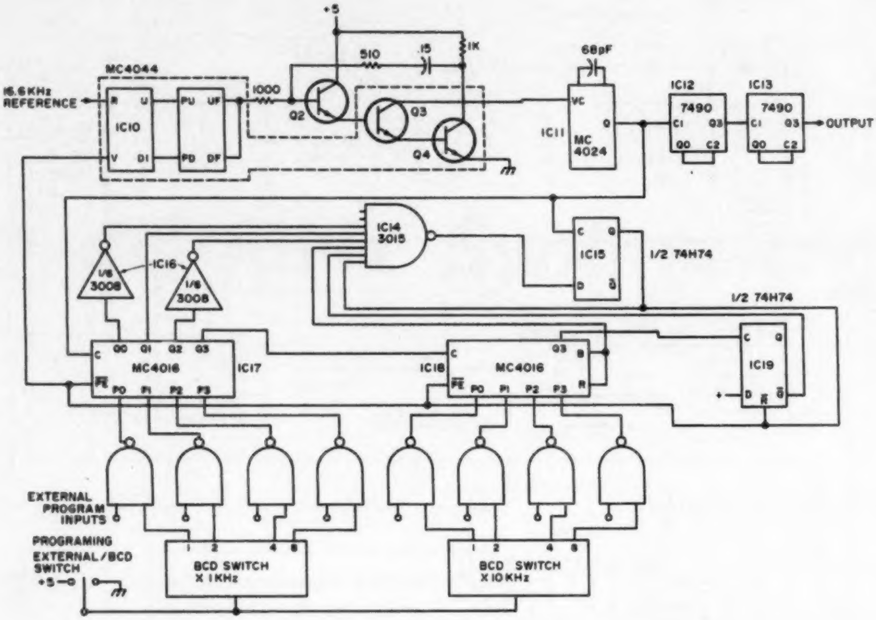

+5
510
.15
1K
68pF
MC4044
16.6KHz REFERENCE
R U
IC10
V D1
PU UF
PD DF
1000
Q2
Q3
Q4
VC
IC11
Q
MC 4024
IC12
7490
C1 Q3
Q0 C2
IC13
7490
C1 Q3
Q0 C2
OUTPUT
IC14 3015
C Q
IC15
D Q̄
1/2 74H74
IC16
1/6 3008
1/6 3008
1/2 74H74
C Q
IC19
D R Q̄
+
Q0 Q1 Q2 Q3
C
MC4016
IC17
PE P0 P1 P2 P3
IC18
C
MC4016
Q3 B
PE P0 P1 P2 P3 R
EXTERNAL PROGRAM INPUTS
PROGRAMING EXTERNAL/BCD SWITCH
+5
1 2 4 8
BCD SWITCH X 1KHz
1 2 4 8
BCD SWITCH X 10KHz

Fig. 10. PLL B.

Its output is fed directly into a programmable divider formed of ICs 17, 18 and 19. The divider is programmable by front panel switches or external inputs to divide by any integer between 100 and 199. ICs 14, 15 and 16 perform the early decode function.

The output of the divider is fed into phase detector IC10 along with a 16.666 kHz reference. The output of the charge pump is fed into an integrator formed of transistors Q2, Q3 and Q4 – Q3 and Q4 being part of IC10. The loop is completed by coupling the output of the integrator back into the VCO.

ICs 12 and 13 divide the VCO output by 100.

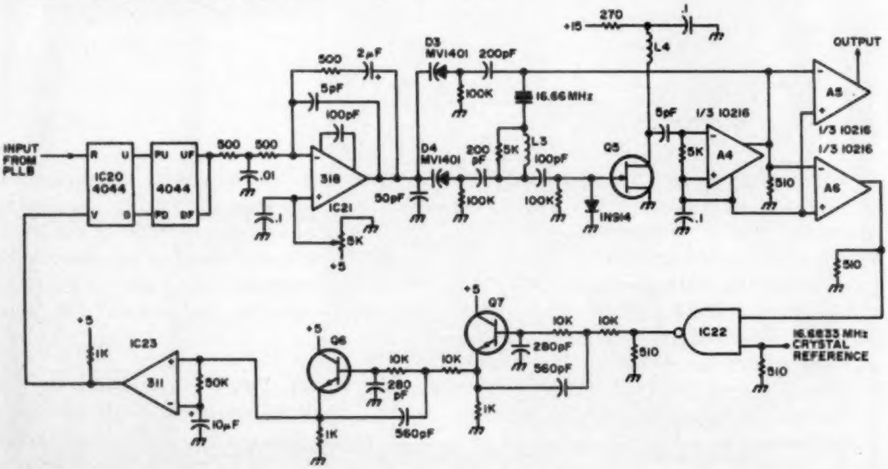
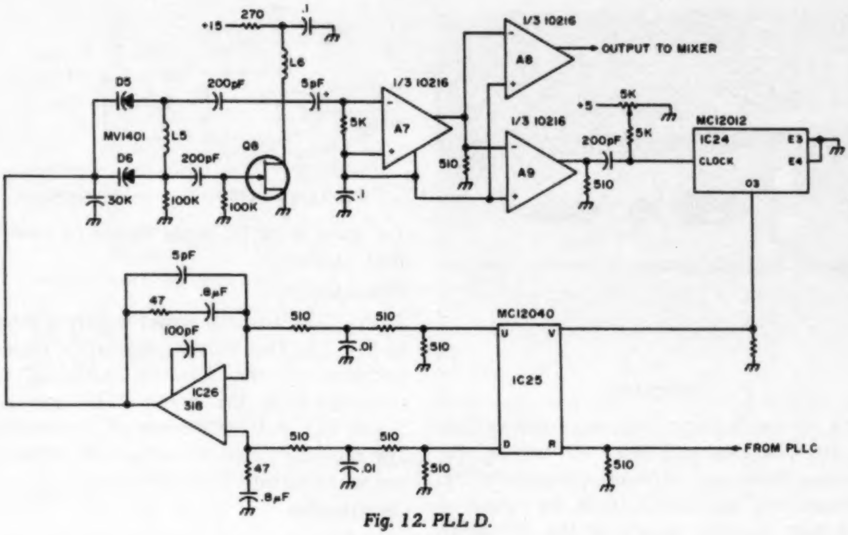

+15
270
.1
L4
OUTPUT
D3 MV1401
200pF
100K
16.66MHz
500
2μF
5pF
100pF
INPUT FROM PLLB
R U
IC20 4044
V D
PU UF
4044
PD DF
500
500
.01
318
IC21
.1
5K
+5
50pF
D4 MV1401
200 pF
5K
L3
100pF
100K
100K
IN914
Q5
5pF
1/3 10216
5K
A4
.1
510
A5
1/3 10216
1/3 10216
A6
510
+5
IK
IC23
311
50K
10μF
+5
Q6
10K
280 pF
1K
560pF
+5
Q7
10K
280pF
560pF
10K
10K
1K
510
IC22
16.6833 MHz CRYSTAL REFERENCE
510

Fig. 11. PLL C.



+15
270
.1
L6
D5
200pF
5pF
1/3 10216
A7
5K
MV1401
L5
D6
200pF
Q8
30K
100K
100K
.1
1/3 10216
A8
OUTPUT TO MIXER
+5
5K
1/3 10216
A9
510
200pF
5K
510
MC12012
IC24
CLOCK
E3
E4
O3
5pF
47
.8μF
100pF
IC26
318
510
510
.01
510
MC12040
U
V
IC25
D
R
510
510
.01
510
47
.8μF
510
FROM PLLC

Fig. 12. PLL D.

PLL C

The circuit of PLL C is shown in Fig. 11. FET Q5 and A4 form a voltage controlled crystal oscillator capable of pulling the crystal frequency by nearly 0.3%. D3, D4 and L3 form a voltage controlled delay network which varies the point in the cycle at which drive is applied to the crystal; A4 amplifies and clips the feedback signal to maintain uniform drive and stable operation even at long phase delays. A5 and A6 are buffer amplifiers.

IC22 is an ECL NAND gate which serves as a mixer. Q6 & Q7 are connected as low pass filters to leave only the difference frequency, and comparator IC23 amplifies and squares the signal to TTL levels.

This signal, along with the output of PLL B, is fed into phase detector IC20. The output of the charge pump is fed through a low pass RC filter and then into the integrator, IC21. The loop is completed by connecting the integrator to the VCO. The use of a voltage controlled crystal oscillator has a number of advantages. First of all it has virtually no internal noise, and this keeps synthesizer output clean. Second, because of its very limited frequency range, no provision has to be made to prevent the PLL from attempting to lock to the upper beat frequency rather than the lower.

PLL D

The schematic of PLL D is shown in Fig. 12. Q8 is connected as a voltage controlled oscillator, with buffer A7 and squaring amplifiers A8 and A9.

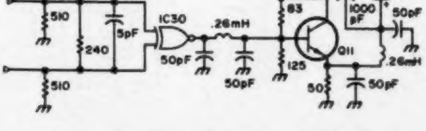
A9 is coupled to prescaler IC24, in this case used as a fixed ÷6 prescaler. The output of the prescaler is fed along with the output of PLL C into IC25, a high frequency ECL version of the 4044 phase detector.

Because of the high frequency, a charge pump is no longer used, and the output of the phase detector is fed through low pass RC filter sections into a differential integrator.

This PLL operates as a fixed X6 frequency multiplier.

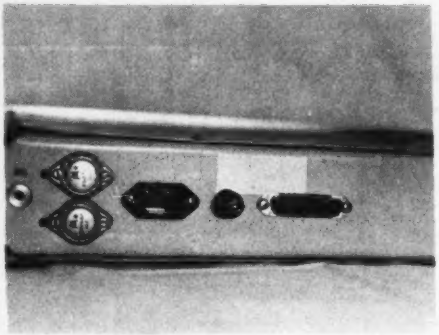
Mixer/Amplifier

The circuit of the mixer/amplifier is shown in Fig. 13. The outputs of PLL A and



+5
10
1000pF
510
5pF
240
IC30
.26mH
50pF
50pF
83
125
Q11
1000 pF
10
50pF
.26mH
50
50pF
510

Fig. 13. Mixer/Amplifier and filters.



Rear view.

PLL D are fed into ECL exclusive *or* gate IC30. The gate multiplies the two signals, mixing them very efficiently. Because of the limited slew rate of ECL IC30, the output of the gate consists mainly of the difference between the input frequencies. To remove any of the sum of the input frequencies that is present, as well as feedthrough of the frequencies themselves, the output of the gate is fed through a 60 MHz low pass filter. Q11 acts as an emitter follower, and the signal is finally fed through another low pass "pi" section before the output jack.

Crystal Oscillators

The schematic of the two crystal oscillators is shown in Figs. 14 and 15. The low frequency oscillator (Fig. 14), consists of untuned FET oscillator Q9, comparator IC27 which produces TTL signal, and TTL dividers IC28 and 29.

The high frequency oscillator, shown in Fig. 15, consists of tuned FET oscillator Q10, and buffer amplifiers A10 and A11. For good stability, ovens should be used for both oscillators.

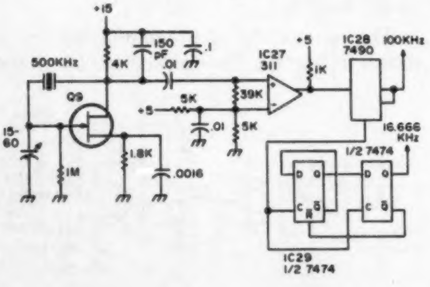


Fig. 14. 100 kHz reference oscillator.

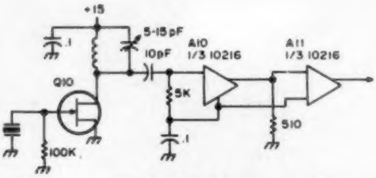


Fig. 15. 16.6833 MHz reference oscillator.

Power Supply

The circuit of the power supply is shown in Fig. 16. The multiple regulators provide isolation of the sensitive parts of the circuitry from the noisy TTL, and also isolate PLL A from the rest of the circuitry. The regulators used are completely standard, so I won't go into their operation.

Construction

I shall not give complete construction details in this article. The circuit boards and physical arrangement of the prototype were designed around some shielded boxes I happened to have, and the arrangement, while convenient, was not ideal.

However, there are some guidelines which I feel would be useful to anyone designing his own, and these follow.

ECL Connection Techniques

The rise and fall times of the ECL used in the synthesizer are around 1.5 ns, and some care must therefore be taken to reduce crosstalk and ringing.

The ECL gates and amplifiers contain an emitter follower output transistor, but no load resistor. The placement of the load resistor and its value depends upon the length of wire used and its characteristic impedance. Ideally the termination resistor should be placed at the far end of the wire and have a value equal to the characteristic impedance of the wire or transmission line used.

In practice the rules can be simplified a bit. For wires less than 8" in length it is sufficient to use a 510 Ohm resistor placed as near to the terminal end as possible. For longer lines it is easiest to use 50Ω coax terminated in a 50Ω resistor to +3 volts, or the two resistor equivalent thereof shown in Fig. 17.

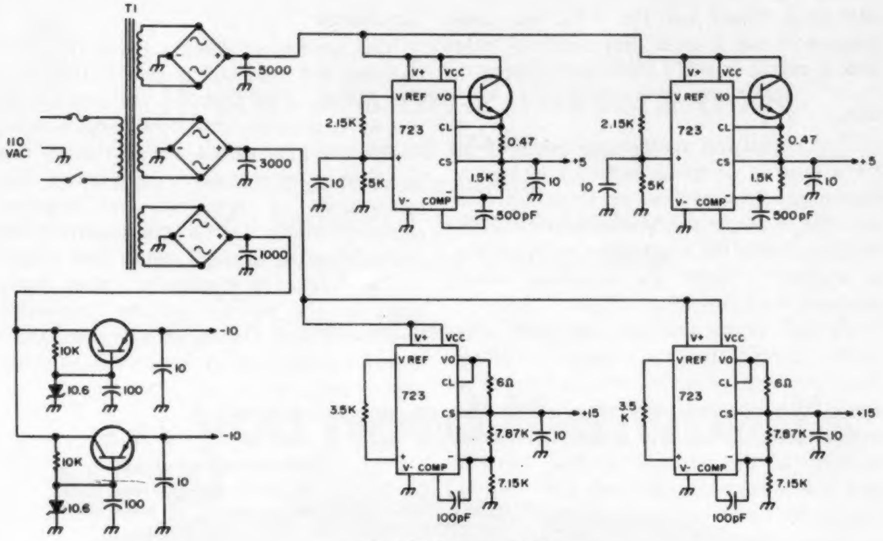


Fig. 16. Power supply.

Shielding

As in any rf generator, shielding is of paramount importance. Any noise which gets into a PLL will cause sidebands. Ground loops, discussed later, are one prime culprit; the other harder-to-deal-with one is electromagnetic coupling between two oscillators in the synthesizer, when they are operating close to harmonics of the same frequency.

Putting each oscillator in a separate shielded box is a must, and the boxes should be isolated from each other by as much distance as possible, with any extra shielding that can conveniently be added.

Ground Loops

Ground loops are feedback paths between different parts of the synthesizer caused by IR drops in a common ground wire. These can be very troublesome, and can easily lead to large sidebands. The best way to eliminate them is to connect each circuit to a central ground through a separate wire. Do not use different points on the chassis as multiple grounds because loops can occur even in a 16 gauge aluminum chassis. Even when a single common ground is used problems can still occur, and it is often helpful to connect various ground points together with a #12 wire to find ways of improving the network.

Power Supply

Care must be taken in the design of the power supply to prevent it from becoming a source of noise or a feedback path. High quality IC regulators should be used along with generous filter capacitors to reduce ripple to a minimum. Separate regulators should be used for noisy circuits like programmable dividers, to isolate them from the sensitive oscillators and phase detectors.

Every single circuit board should be bypassed at least once for every 2-3 ICs, with a 5-30 uF tantalum and/or a .001-.01 uF ceramic disc.

Circuit Boards

The prototype used 18 small printed circuit boards and an Augat wire-wrap board for most of the TTL. The large number of small boards was due to the requirement that they fit into the shielded boxes. The

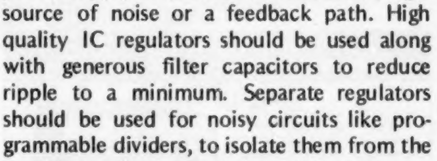


Fig. 17. ECL termination techniques.

wire-wrap board for the TTL was used because it was a great deal easier to make than a circuit board; I highly recommend it.

Uses

The completed synthesizer can be used for a number of things besides a frequency source for transmission or reception. For example, a simple digital control unit can be built to enable the synthesizer to be used as a scanner – like the scanning police receivers, for example.

Or the synthesizer can be used with another control circuit as a response analyser for filters and i-f amplifiers. The response would be displayed as a curve on a scope with precise frequency markers. A small addition to the response analyser turns it into a spectrum analyser with CRT display and precise frequency markers.

The synthesizer can be turned into an FM source by opening PLL C and modulating the VCXO directly. Continuous variation of frequency with no loss of stability can be obtained merely by using a potentiometer to vary the dc bias on the VCXO.

Conclusion

The synthesizer described here is a very complex and expensive project. It may take a month or a year to build, and you can be sure of running into problems along the way.

But once completed, the synthesizer is a joy to use, and can form the heart of such instruments as spectrum and response analysers, which are far too expensive for the amateur to buy, no matter how useful.

The frequency synthesizer, after many years in the position of the impossible dream, is finally coming into its own, and I look forward in the coming years to many new designs, better and more elegant than the one described here.

Semiconductor Parts List

Q1, Q5, Q8, Q9, Q10 – MPF108
Q2 – 2N2369A
Q7, Q6 – MPS-A12
Q11 – MM8001
D1-D0 – MV1401
A1-A12 – MC10216L
IC1, IC24 – M12012L
IC2 – MC12014L
IC3, IC4, IC5, IC17, IC18 – MC4016P
IC6, IC15, IC19, IC29 – 7474
IC7, IC10, IC20 – MC4044P
IC8, IC9, IC21, IC26 – LM318H
IC11 – MC4024P
IC12, IC13, IC28 – 7490
IC14 – 74H30 or 3015
IC16 – 74H04 or 3008
IC22 – MC10104L
IC23, IC27 – LM311H
IC25 – MC12040L
IC30 – MC10107L

Coils

All coils wound on 5/16 Q3 toroid, Indiana General F625-9 Q3
L1 – 3T #20
L2 – ~1 layer #26 solid hook-up closewound
L3 – ~1 layer #26 solid hook-up loosewound
L4 – ~2 layers #28 magnet wire
L5 – 3T #20
L6 – ~2 layers #26 solid hook-up

References

Motorola data sheets for the following:

MC4324 • MC4024
MC4344 • MC4044
MC4361L • MC4016L,P
MC12014
MC12012

Motorola MECL IC Data Book, 3rd ed.
Motorola MECL System Design Handbook

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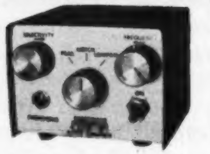

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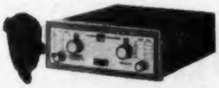
☐ 

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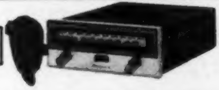
☐ 

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Conclusion

The FAX recorder can be built from a wide variety of materials. The ones I used are specified in the line drawings. If you are a machinist, know one, or have the extra cash to hire one, you can obviously turn out a very classy unit. If not, you will scrounge the hardware stores. You should think the whole business out before hand and make sure you have a good solid idea about how the parts should interact. There are a few general guidelines that you should keep in mind:

(1) Assemble the drum, shaft and bearing unit first. The drum should turn absolutely freely; otherwise, re-do it. The mounting of the motor on the mounting plate and the alignment of the plate itself should be done with extreme care so that the drive shaft of the motor is precisely in line with the drum shaft. The two are coupled with stiff rubber tubing. Free movement of the drum and proper alignment of the drive motor are the two most important factors affecting the quality of your final pictures.

(2) The carriage track for the light gun assembly should be precisely parallel to the drum. The width of the track should be adjusted to provide a smooth sliding fit with the piece of wood used for the base of the light gun carriage. A piece of window glass the length of the carriage track, and cut to the width of the space between the rails, is epoxied to the base plate to provide a smooth bearing surface for the light gun carriage.

(3) The wooden pillars of the light gun carriage should be just the length needed to bring the center axis of the light gun tube to

the same height as the center of the drum. Final positioning of the tube on the pillars, prior to epoxying the tube in place, should be done in such a way that the light from the gun comes to a sharp focus on the face of the drum with the lens mounted half-way into the tube. This will provide some range for final focusing once the unit is completely assembled. The hole of the traverse nut should be aligned with the center line of the carriage base, and the mounting plate for the nut should be adjusted so that it is precisely at right angles to this center line.

(4) The mounting of the traverse motor and its mounting plate should be done carefully so that the motor drive shaft is lined up with the center of the carriage track and at the same height as the traverse nut on the light gun carriage. The ¼" -20 threaded rod for the traverse assembly should be straight with smooth threads. Any roughness in the threads of the traverse rod or nut should be eliminated prior to final assembly. Some brands of hardware are better than others, so check them out before you find that there is too much binding for smooth traverse operation.

(5) Standard 1¼" diameter telescope eyepieces can be used in the light gun assembly to focus the light gun output to a small point on the paper wrapped around the drum. The shorter the focal length of the lens the sharper the point of light. This is particularly critical with rolling pin drums because of the smaller image format. The 6mm lens offered by Edmund Scientific is ideal (Cat. #30,204; Edmund Scientific Co., 602 Edscorp Building, Barrington NJ 08007; $4.74 in their 1975 catalog). Such lenses can often be obtained locally, but don't fork out for a premium version; in this application quality is not important. A 10X or better yet a 15X microscope eyepiece can also be used, but such eyepieces have a smaller diameter than those used for telescopes, and an adapter will be required. Again, Edmund comes to the rescue with their Cat. #30,199 ($1.95), a small machined adapter with set screw to convert microscope eyepieces to 1¼" diameter.

(6) The motor reversing switches and the capacitors that come with the synchronous motors can be mounted on the motor mounting plates. Power leads for the motors and the light gun can be routed to connectors on the main chassis where switches can be used to control the on-off functions of these units.

Set Up and Use

The Solid State Module

(1) Connect a frequency counter to the input (pin 1) of IC3.

(2) With S1 in the receive position (1) adjust the 60 pF trimmer capacitor for a frequency of exactly 4.8 MHz. Put it on frequency as close as the resolution of the counter will permit.

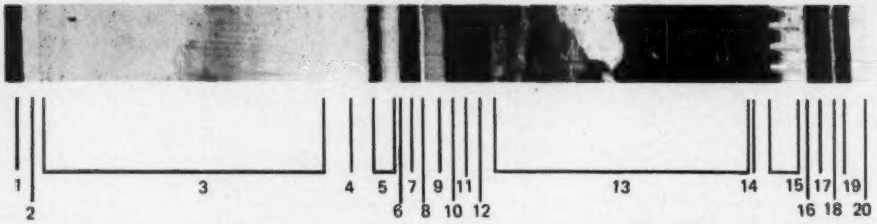
(3) Place S1 in position 2 (display) and adjust the 5k VCO frequency pot near the NE 565 for a frequency of 4700 Hz with S2 open.

(4) With S2 still open check the frequency of the 48 Hz output – with the VCO free running at 4700 Hz the frequency should be 47 Hz.

(5) Switch S1 back to receive and put the counter on output jack A. A frequency of 4800 Hz should be obtained.

(6) Temporarily connect the output of jack A to the input of the 565 (normally connected to the left channel output of the tape deck). Leave S1 in the receive position but connect the counter to pin 4 or 5 of the 565. With S2 open, a frequency of 4700 Hz should be obtained. Closing S2 should result in a shift to 4800 Hz, indicating proper tracking and lockup of the phase locked loop.

Before going on to check out the remaining circuits, it will be necessary to prepare or have available a satellite recording. Any stereo tape deck will suffice. The satellite video should be recorded on the right channel. Set the recorder level for maximum permissible VU meter reading on the noise output of the receiver and you can be assured the satellite video will not exceed this limit. The 4800 Hz reference signal should be recorded on the left channel simultaneously with the satellite video. A 1/4-1/2 scale VU level is entirely adequate for the reference signal as very little output is needed for reliable lockup. The only control that is critical during the receive phase is the position of S1 – it should be set



Line format for the NOAA video signal. Each line at the 48 Hz line rate requires 1250 ms for completion. The sequence shown above was phased to show the sequence as transmitted. Each component is listed below with its duration in milliseconds in parentheses.

1 – pre-earth IR sync pulse (23.31)
2 – pre-earth IR space scan; white (24.47)
3 – IR earth scan (377.78)
4 – post-earth IR space scan; white (61.11)
5 – IR channel grey scale (50)
6 – back porch; white (10)
7 – playback synchronization pulse; black (30)
8 – front porch; white (10)
9 – back scan and overlap allowance; grey (23.23)
10 – sync delay; black (15.1)
11 – pre-earth VIS sync pulse (23.31)
12 – pre-earth VIS space scan; black (24.47)
13 – VIS channel earth scan (377.78)
14 – post-earth VIS space scan; black (61.11)
15 – VIS channel grey scale and telemetry (50)
16 – back porch; white (10)
17 – playback synchronization pulse; black (30)
18 – front porch; white (10)
19 – back scan and overlap allowance (23.23)
20 – sync delay; white (15.1)

For most seasons of the year the modulation levels of the IR and visible channels differ, as shown above, so different gain settings are required for optimum display. The example shown above is for a daylight pass where both IS and VIS data are available. The format for evening passes is identical except that the VIS channel earth scan (13) is black due to insufficient light for operation of the visible light sensor.

to receive (position 1) if the proper reference signal is to be recorded.

The Drum Motor Amplifier

(1) Connect the input of the 565 circuit of the solid state module to the output of the left channel of the tape deck. Place S1 in the display position and close S2.

(2) Connect the output of the amplifier to the drum motor and set the 6DQ5 bias pot for -50 V on the pot center arm.

(3) Monitor the ac voltage on the drum motor leads and gradually increase gain at R2. The motor should start to operate somewhere between 80 and 100 V ac, but continue to advance R2 until the motor is running on 120 V ac. Leave R2 in this position.

The Lamp Driver

(1) Open S3 and set R1 for +2.9 V on the center tap of T2.

(2) Plug the R1168 glow modulator cable into the chassis. The tube need not be mounted in the light gun at this time.

(3) With no video input to the 12AU7, close S3 and adjust the black level control for a lamp current of 15 mA. Open S3.

(4) Connect the input of the 12AU7 to the output of T1 and the input of the video filter in the solid state module to the right channel output of the tape deck.

(5) Apply a recorded video signal to the solid state module, close S3, and advance the video gain control of the solid state module. As you watch both the meter in the video amplifier and the meter in the lamp circuit, you will note that video peaks in the solid state module correspond to drops in the lamp current (M2). Increase the video gain to the point where video peaks cause a drop to 1 mA in the lamp current as indicated by M2.

(6) Observe the R1168 glow tube. It should flicker in brightness in response to the applied video signal.

The Facsimile Recorder

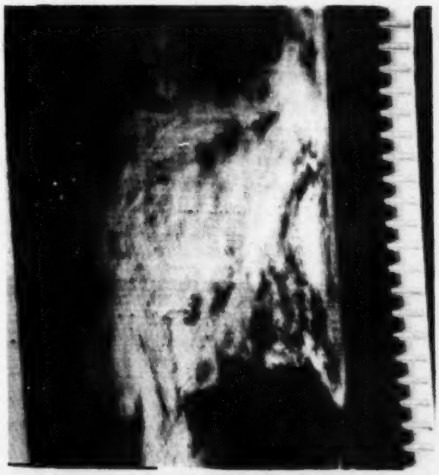
Initial setup of the FAX recorder is simply a matter of seeing that the drum turns properly and that the traverse assembly moves the light gun smoothly along the length of the drum. 110 V 60 Hz ac can be used for both motors in initial testing of the mechanical system. Listen carefully to the drum motor as the drum turns. The motor gear train should make little noise and there should be little variation in noise as the motor operates. Visible hesitation in the drum as it rotates or obvious variations in motor noise output indicate a binding or out-of-alignment condition of the motor and drum, and should be eliminated. A little light oil on the bearings will keep things operating smoothly once basic alignment is achieved. The traverse assembly should move the carriage smoothly in its track. Visible hesitation, jerks or binding will spoil the picture. A small amount of light oil on the traverse screw threads will help. The base of the carriage assembly should be sanded smooth and a small amount of talcum powder can be used as a lubricant on the glass plate of the carriage track. Use very little, as it need hardly be visible to do the job. Too much powder will have the carriage lurching over masses of powder and doing more harm than good. Cycle the reversing switches to verify that the motors will reverse properly. With the layout shown, both motors must run in the same direction for recording a pass; otherwise, the picture will be a mirror image. As viewed from the front of each motor, clockwise rotation is required when the light gun moves from the left end of the drum to the right (viewed from the carriage), while counterclockwise rotation of both motors is required to print a picture in the opposite direction (right to left).

To reduce reflections, paint the inside of the light gun assembly a flat black. The glow tube envelope should also be painted except for a small spot on the top to pass the light from the crater assembly at the tube apex. Adjust the lens of the light gun for sharpest focus on the drum. A blank piece of photographic paper should be wrapped around the drum for this step, as the thickness of the paper is sufficient to throw off the proper focus setting.

Printing The First Picture

The photographic paper used to make the FAX prints needs not be handled in absolute darkness; safelights of certain colors can be used if the paper is not kept too close to the lamp. The initial black current value previously set (15 mA) is based on the use of Kodak Polycontrast Rapid paper, one that is quite sensitive and which will produce pictures of good contrast. An old-fashioned red safelight or the Kodak OC safelight (amber) will not expose the paper if reasonable care is taken. I use two safelights in my basement shack – one near the FAX recorder so I can load paper and watch meters during a run, and the other at the far end of the basement where I actually process the paper. Time and space don't permit a complete description of the proper precautions for handling photographic paper and the details of processing, so if you have had no experience in this area I would seek out a local photo hobbyist or camera shop proprietor for details. All of the steps to be described should be performed in darkness, except for the safelight illumination, unless otherwise noted. I will assume that the satellite recording you have available is a daylight pass containing both visible channel and IR data.

Wrap a piece of 5" x 7" paper around the



Visible channel output from a NOAA-4 pass over the cloud covered central United States on 23 February 1975. The visible channel grey scale and telemetry can be seen on the right margin following the black post-earth space scan.

drum lengthwise with the emulsion facing out. Double sided Scotch tape can be used to fasten the paper in place. The direction of motor rotation (drum and traverse) should be consistent with the direction you plan to move the light gun (see FAX recorder setup). Close the switch to start the drum. The phasing switch on the solid state module should be closed. Turn on the recorder, start the traverse motor and then close S3 to light the glow lamp. After 10 minutes or so have passed, turn off the lamp, traverse motor, recorder and drum, in that order. Remove the paper from the drum and take it to the processing area. I process my papers in Kodak Versatol developer (1 part of the Versatol liquid to 3 parts water) for 1 minute. Rinse the paper in water for a few seconds and transfer to the fixing solution. I use Kodafix fixer (1 part Kodafix to 7 parts water) and fix for 5 minutes. After 1 minute in the fixer the normal room lights can be turned on. What you should see is a photo showing the visible channel, IR channel, and all the intervening telemetry, grey scales, etc. The IR channel will probably be washed out, especially in winter; what we want to look at carefully now is the visible channel.

If the visible channel image looks like that of the photo shown (general range of contrast) you are home free. If it is too dark (the lightest clouds are grey rather than white and the grey scale is not properly displayed), you must reduce the black current slightly and try again. If you reduce black current, also reduce video drive to maintain a "peak video" indication of 1 mA in the lamp circuit. If the visible channel image is too light we must increase black current and increase video drive. In no case do we want to exceed 20 mA of lamp current – you should be able to print good pictures at between 10 and 15 mA. Make add adjustments in small steps and eventually you will get the black current and drive setting that will produce excellent pictures. Similar adjustments can be made to optimize the IR pictures. Optimal IR settings will change radically according to the season of the year, but a little experimentation will provide good IR display. It is unusual to get good display of both images simultaneously due to differences in the modulation levels employed. The best opportunity for good simultaneous display comes in the summer, when IR video gets as dark (warm) as it is ever going to get.

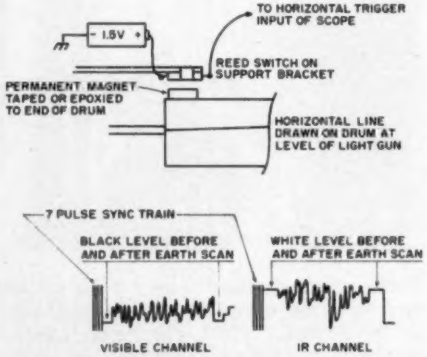

TO HORIZONTAL TRIGGER INPUT OF SCOPE
- 1.5V +
REED SWITCH ON SUPPORT BRACKET
PERMANENT MAGNET TAPED OR EPOXIED TO END OF DRUM
HORIZONTAL LINE DRAWN ON DRUM AT LEVEL OF LIGHT GUN
7 PULSE SYNC TRAIN
BLACK LEVEL BEFORE AND AFTER EARTH SCAN
WHITE LEVEL BEFORE AND AFTER EARTH SCAN
VISIBLE CHANNEL
IR CHANNEL

Fig. 7. Circuit additions to provide phasing capability.

Picture Phasing

If your drum size requires phasing or you want phasing capability to assure that you never have to repeat a picture, it can be accomplished fairly easily if a triggered scope is available. Fig. 7 shows the additional components required. A small permanent magnet is taped to the drum at one end. A small magnetic reed switch is mounted on a small bracket so that it is closed by the magnet once during each revolution of the drum. A small 1.5 V battery provides a trigger pulse to the scope horizontal circuit each time the switch is closed. Provision should be made to switch the video output of the solid state module to the vertical input of the scope during phasing. With the magnet aligned with the reed switch, mark a line on the drum that is lined up with the light gun. When wrapping paper on the drum, the edge of the paper should be placed on this line. Now, as the drum rotates, the trigger pulse will be produced as the edge of the paper passes the light gun. The insets of the visible channel photo show the proper scope display for phasing either the IR or visible light image. The phasing switch of the solid state module (S2) is opened until the seven pulse sync pulse of either the IR or visible light image is lined up with the left side of the scope display, at which point S2 should be closed. The video output of the solid state module is then switched back to the lamp driver circuit and you are ready to print the picture. With a little practice, the phasing operation only takes a few seconds.

Relative Advantages of FAX and CRT Display

One of the principal advantages of the FAX system is the low cost of operation when pictures are acquired on a daily basis. "Instant" pictures with the CRT system require the use of Polaroid film, which quickly causes operating costs to soar when used daily.

Instant readout with FAX involves relatively inexpensive photographic paper. The processing time required to obtain the final print is minimal and the print can be viewed just a few minutes after a pass is finished. A disadvantage of the FAX system is that you are locked into a fixed size format determined by the drum size. With the CRT system and 35mm film, it is possible to blow up pictures to any desired size should the scene be worth the effort. I presently use the FAX equipment for my daily file pictures and retake particularly interesting shots using the CRT system so that I can make enlargements later. In addition to the fixed size format, any change in the line rates for a satellite system requires a change in motors. The CRT system on the other hand can readily be designed to accommodate a number of video modes, and a change in line rates can be accomplished inexpensively by simply altering the division chains in the CRT unit.

The CRT display system is vulnerable to one major problem which is common to SSTV display systems as well – unwanted deflection of the scanning line by 60 Hz fields from adjacent power transformers. FAX, involving as it does a completely mechanical scanning system, is not prone to that particular problem. The mechanical nature of FAX does have some drawbacks in that strictly mechanical problems need be attended to, and periodic care and maintainance of the FAX recorder is required to keep it in top operating condition. The all electronic CRT system does not require such care. As a final note, the typical CRT system with its complete and easy control of system contrast usually can provide the best possible resolution of low contrast terrain features which may be harder to see, although they are always present, in the FAX pictures. Intense white cloud features, however, are often washed out in CRT displays because of slight blooming of the CRT trace at high brightness levels. The FAX system excells at retaining fine resolution in very bright cloud structures.

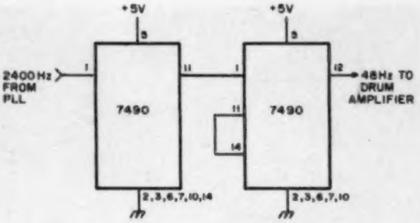
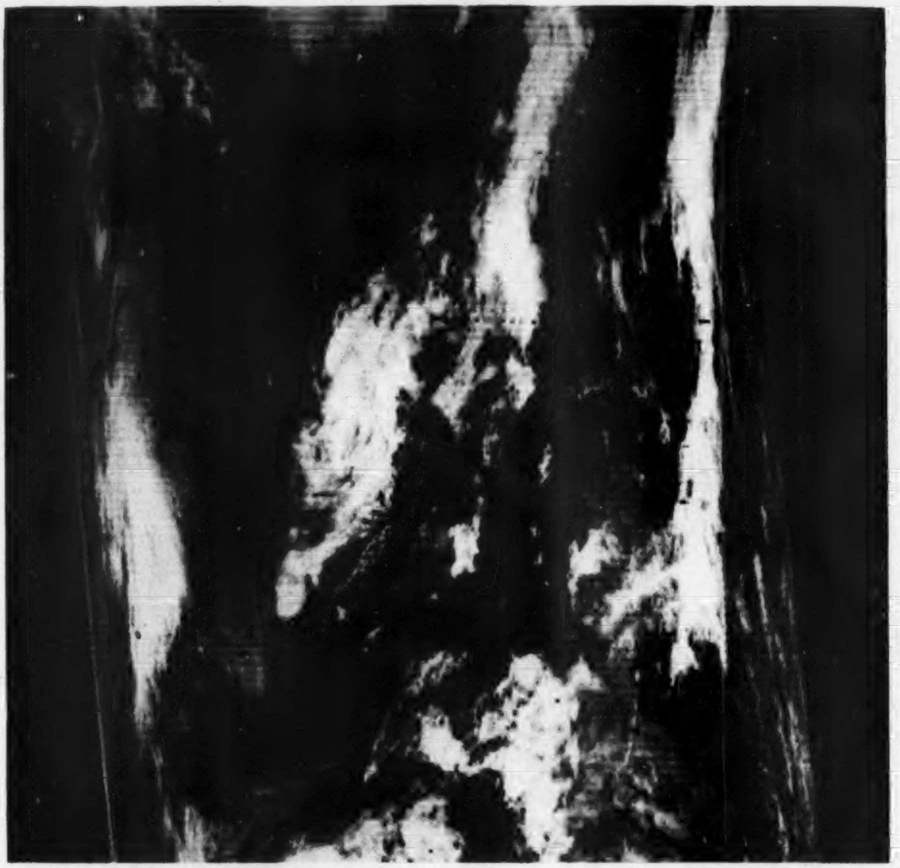


Fig. 8. Additional divider chain for 48 Hz, for use with CRT systems with a 2400 Hz phase locked loop.

As the foregoing discussion should indicate, the best possible solution is to have both systems available in an active satellite station, although either system alone will provide effective performance on a day to day basis.

Adding FAX Capability to an Existing CRT System

The various CRT systems I have previously described in 73 Magazine (Sept. 74, Dec. 74) all utilize a 2400 Hz phase locked loop with appropriate count down chains to derive the trigger rates for APT or DRIR display. The FAX system described here can be added to such a system with very little effort. All that is needed is to provide a new divider chain for the system that will develop 48 Hz to drive the drum amplifier. The logic diagram for such a divider chain is shown in Fig. 8. The High Z video output of any of the previously described systems will drive the lamp driver circuit with no problems. The only provision which must be added for FAX use is that the retrace and line blanking circuit for the CRT video must be disabled when the signal is used to drive the FAX video circuits. In my own system I use center "off" switches in the blanking



NOAA-4 visible channel view of the eastern U.S. on 13 May 1975. The original has a 4 x 6 inch format and was made using a rolling pin drum operating at 96 rpm (120 rpm motor on 48 Hz), with double the normal traverse motor speed for the drum size. Such larger format pictures present excellent resolution while minimizing the need for precision focusing of the light gun. The Great Lakes are visible just above and slightly to the left of the center of the picture.

circuit to accomplish this. If you already have a basic CRT display system with the modifications noted above, simply add the drum amplifier, lamp driver, and FAX recorder, and you are in business with FAX as well. If you plan to utilize just facsimile display, the solid state module described in the present article is your best bet since the circuits are somewhat simpler than those required for a CRT system.

The FAX system described here will provide excellent results with NOAA satellite pictures. If you use a small drum with a relatively small picture format be sure to exercise care in focusing the light gun so you will not lose resolution. With the components specified, even very small pictures should show perfectly clear line structure revealing all the information the satellite pictures have to offer. Larger drum sizes with resulting larger picture formats make focusing less critical, but it should still be done carefully. I will be happy to answer any questions regarding the system, but please provide an SASE if you write.

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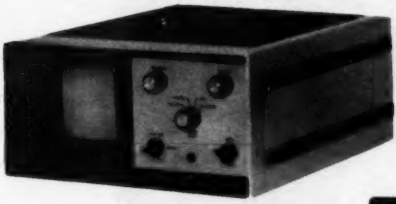

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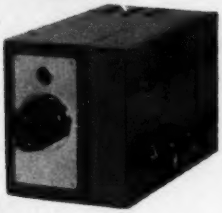

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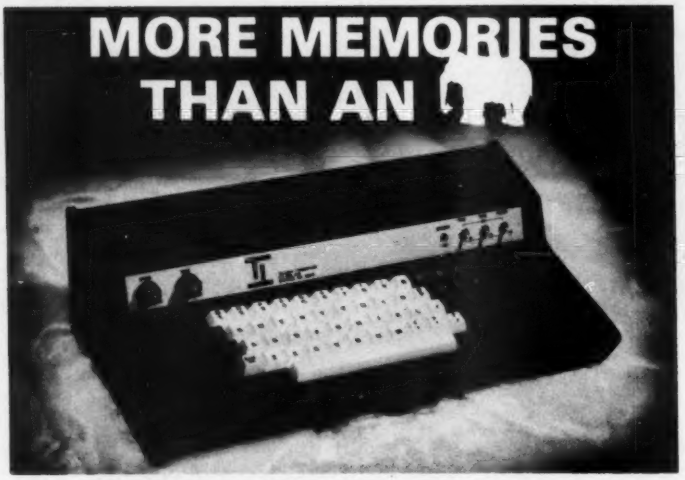

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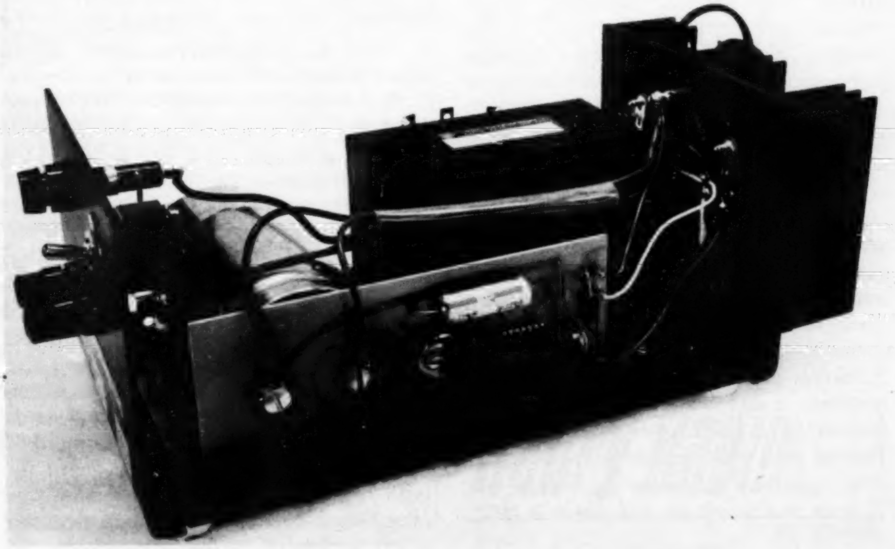
Dispelling the Mystery of Regulated Supplies

Regulated power supplies are a mystery. Almost every IC construction project includes a regulated supply and most amateur solid state equipment built for 117 volts also has a regulated supply or supplies to power the low voltage solid state devices. But the mystery is that while most amateurs have a good idea of how to use transistors and integrated circuits in simple applications, few have the remotest idea of how the regulated supply works and fewer still could design one from scratch if required to. This article is written to dispel the mystery and give the hows and whys of regulated supplies.

This article discusses the operation of regulated power supplies for low voltage applications and gives all the necessary information needed to design a regulated supply from scratch. Information is given so that the designer may select the proper components such as the transformer, diodes,



Typical regulated supply.

capacitor, regulator, pass transistors and heat sinks. References such as those listed at the end of the article will be helpful, but not required, since this article lists all components and gives various alternates so that the designer can design power supplies for various voltage and current combinations. Sources for all parts are given so that the designer won't be stuck for some hard to find parts.

The regulated power supply consists of an unregulated dc power supply feeding a regulating circuit. The unregulated dc supply may consist of a full wave rectifier feeding a filter capacitor as shown in Fig. 1 or it may be a battery used in a mobile or portable installation. The regulating circuit may be a circuit made up of discrete components or it may be a regulating IC, such as the NE550 used in this article. Components and design options are chosen according to the voltage and current requirements of the project needing the regulated supply.

Integrated circuit voltage regulators are commonly used today, rather than discrete components, because of their low cost and ease of use. The basic design in this article comes from the Signetics *Digital, Linear, Mos*[1] manual and is based on the Signetics NE550 regulator IC. This basic design is simple and permits numerous output voltages and limiting currents by merely selecting readily available resistor combinations.

The Dc Power Supply

The dc power supply used for most low voltage power supplies is a capacitive load circuit as shown in Fig. 1. Inductive filters are occasionally used instead of capacitors, but high value, high current inductors are more difficult to locate and more expensive than low voltage high-value capacitors. Either a full wave (Fig. 1) or half wave (Fig. 2) circuit may be used to supply the dc; however, a full wave circuit is preferred because it provides better basic regulation. The full wave circuit is used in this design.

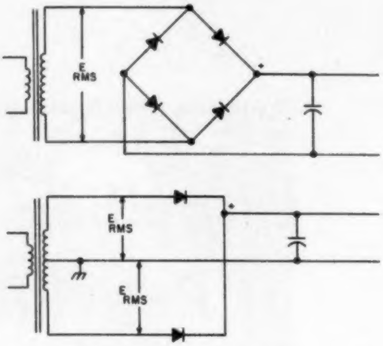


Fig. 1. Full wave circuits. A. Bridge. B. Center tapped transformer.

In order to determine the voltage and current ratings of the components to be used in the unregulated dc power supply, it is first necessary to determine the voltage and current requirements of the equipment or device to be powered. When determining these power requirements it is best to allow reasonable safety factors in order to prevent overheating and to insure that the equipment will operate correctly. I normally allow a current safety factor of 10% in cases where I am drawing peak current 50% of the time or less. In all other cases I allow a safety factor of 1/3. (It is better to be conservative the first time!)

To determine the required current rating for the transformer use the formula $I = 1.3 \times I_p$ where I_p is the anticipated peak current requirements of the equipment.

The designer may design the basic unregulated dc power supply so that the dc output voltage is anywhere from 30% to 98% of the peak ac voltage of the transformer. If a large value filter capacitor is used, the 98% value may be achieved and little ripple will appear on the output of the basic supply. Unfortunately, very high-capacitance capacitors are expensive and in some cases may be hard to find. Smaller value capacitors are less expensive and easy to locate but will give lower dc outputs and will produce appreciable ripple on the output. For a given dc output voltage (under load) the ac output of the transformer will have to be higher for small filter capacitors as compared to large value filter capacitors. Note that in general it is less expensive to use a transformer of higher voltage with a low-capacitance

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[1] *Digital, Linear, Mos,* Signetics, 1972, p. 6-47.

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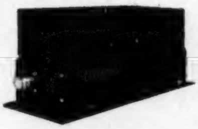

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	1% Resistors		5% Resistors		
E_{reg}	R_A k Ohms	R_B k Ohms	R_A k Ohms	R_B k Ohms	Trimming Resistor
5	6.13	2.97	5.6	2	1k
10	12.3	2.39	11	2	1k
12	14.7	2.31	13	2	2k
13	16.0	2.29	15	2	2k
15	18.4	2.24	16	2	5k
20	24.5	2.18	22	2	5k
30	36.8	2.11	33	2	5k

Table 1.

capacitor for a given dc output than it is to use a large capacitor and a lower voltage transformer to produce the same dc voltage. This is logical since the cost of a transformer does not increase appreciably as the voltage goes up, while the cost of a capacitor increases significantly as the value of capacitance goes up. In order to minimize the cost of the supply, one of the design factors in this article will be to keep the filter capacitor to moderate size and low cost.

Keep in mind that with no load on the output, the dc output from a simple capacitive filter supply will be virtually ripple free. When a load is placed across the supply, ripple will be evident. Further, the amount of ac ripple on the dc output will increase as the size of the filter capacitor decreases (everybody knows that!), but this ac ripple can be significant and not affect the operation of the regulator.

Determining the dc output voltage for a given transformer voltage can be a difficult task if exact values are required. For practical purposes, however, only minimum values, not exact values are needed. For example, if our computations show us that we will get 18 volts dc output from a dc supply, but we really get more than 18 volts, then this is of no consequence. We only want to assure ourselves that we will get at least the minimum required under load. With this in mind, the following formulas[2] can be used to determine the ac (rms) value of the transformer required:

$$E_{peak} = 1.4 \times E_{rms}$$
$$E_{out} = .71 \times E_{peak}$$

Thus $E_{out} = .71 \times 1.4 \times E_{rms}$ where E_{out} is the minimum dc output voltage from the unregulated dc power supply, and E_{rms} is the secondary voltage of the transformer. In summary, the anticipated dc output voltage under load from a simple unregulated supply as shown in Fig. 1 will be equal to or greater than the ac voltage from the secondary of the transformer. (Note: This will only hold true if the current ratings of the transformer are not exceeded.) The above formula takes into consideration that a moderate size capacitor will be used and is based on the assumption that ripple on the dc output voltage can be 10% or less. This assumption is based part on experience and part on charts in the RCA *Solid State Power Circuits*[3] book. (Note that it is not necessary for the average builder to consult this book if the formulas presented in this article are used.) The NE550 regulator IC which is used for the design presented in this article can tolerate 10% ripple provided that the lowest dc input voltage (low part of the ripple) is at least 3 volts higher than the desired dc regulated voltage. Thus, we will have to consider the dc input voltage to be the bottom of the ripple as shown in Fig. 3. Note that the peak voltage cannot be higher than the maximum ratings of the NE550. As defined, $E_{dc\ input} = E_{reg} + 3$, where E_{reg} is the desired regulated voltage. The dc input voltage is also 95% of E_{out} ($E_{dc\ input}$ is 5% lower than E_{out} because of ripple); thus $E_{dc\ in} = .95\ E_{out} = .95\ E_{rms}$. Solving the two equations gives $E_{rms} = (E_{reg} + 3)/.95$. We now have a very simple formula to use to determine the secondary (E_{rms}) value of the transformer given only what we want for a regulated voltage and assuming that we will not exceed the manufacturer's current rating

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[2] ***Solid State Power Circuits,*** **RCA, 1971, p. 260. Assumption: %RS/RL ≤ 15.**

[3] ***Solid State Power Circuits,*** **RCA, 1971, p. 260.**

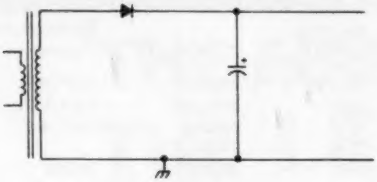

Fig. 2. Half wave circuit.

for the transformer chosen.

These formulas given for I and E_{rms} will hold true for virtually all low voltage, high current supplies provided that good quality properly designed transformers are selected. The transformers recommended at the end of the article fall into that class. If low grade transformers with high internal resistance are used, then E_{rms} may approach a value of $(E_{reg} + 3)/.5$.

As an example, assume that we want a power supply to deliver 5 Amps at 12 volts regulated. The minimum ratings of the transformer would be determined as follows:

$$I = 1.3 \times I_p = 1.3 \times 5 = 6.5 \text{ Amps}$$

$E_{rms} = (12+3)/.95 = 16$ volts. Looking through the various catalogues you probably won't find a transformer that has a secondary exactly matching our requirements, but you would find one that exceeds the requirements. Looking at Table 5 we find that Verada in Lowell, Massachusetts, is offering 6.3 V, 6.6 A filament transformers for $3.75 each or 3 for $10. Three of these transformers with their secondaries in series (primaries in parallel) (Fig. 4) will give an output of 18.9 volts at 6.6 A at a cost of $10.00. This is well less than the equivalent single transformer would cost if purchased from an electronic supply house. Thus three Verada transformers are used in this design with an rms secondary voltage of 18.9 volts

It is a good idea to check the peak dc output voltage obtainable under any circumstances to see that this voltage does not exceed the voltage ratings of the NE550 regulator. The maximum voltage is given by $E_{max} = 1.4 \times E_{rms}$. Thus in our case $E_{max} = 1.4 \times 18.9 = 26.5$ volts. The maximum voltage rating of the NE550 is 40 volts. We are within the limits in this case. In a case where E_{reg} is 37 volts, the maximum allowable for the NE550, or any case where E_{max} exceeds 40 volts, then the circuit in Fig. 5 must be used to provide the dc input voltage to the regulator.

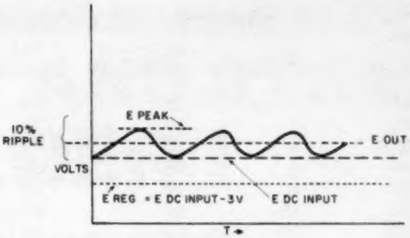

Fig. 3. Ripple on dc output.

Selection of diodes can be made in a fashion similar to the transformer. Diodes in a full wave configuration pass only ½ the total current, thus $I_d = ½ I$ where I_d represents the current requirements of the diodes. In our example, the maximum current is 6.5 Amps, so the diodes would have to handle 3.25 A each. Since this is an oddball value, the next higher current rating would be used such as diodes with a 6 Amp rating. To be conservative for low voltage supplies, the voltage ratings of the diodes should be greater than the maximum peak voltage that can be encountered. For a bridge rectifier configuration, each diode should have a piv (peak inverse voltage) rating of 4 times the E_{rms} value of the transformer secondary, while for a center tapped rectifier configuration the piv should be 6 times the E_{rms} value of the transformer secondary. In our example, diodes in a bridge would have to have a minimum piv rating of 75.6 volts while diodes in the half wave configurations should have a rating of 113 volts. These are oddball values, so we would use diodes of the next higher rating. A bridge with 100 piv rating could be used (Poly Paks 10 A, 100 V bridge) or two diodes in center tapped configuration with a rating of 150 V would do. Note that the current rating for a complete diode bridge (as compared to individual diodes in a bridge) is not divided in half. In this example 6.5 Amps is the requirement, so a 10 A bridge would be required. I prefer diode bridges since they are usually epoxy encapsulated and may be mounted directly to a heat sink without having to worry about

Wattage	Max Current	Minimum dc Current Gain (h_{FE})	Max Voltage	Thermal Derating Factor	Transistor #	Motorola HEP Equivalent
20	2 A dc	25	60	.133 W/°C	MJ2249	HEP241
40	2	25	125	.266	2N5050	HEP241
87.5	4	30	40	.5	MJ480	HEP247
85	4	750	60	.343	MJ4200	–
90	10	20	60	.718	MJE3055	S5001
115	15	20	60	.657	2N3055	HEP704
150	20	500	40	1.2	2N6355	–

Table 2. Transistor selection.

Max. Current	Max. Volts	Maximum Temp. Without Derating	Diode #	
1	200	–	HEP 156	Heat Sink Not Required
2.5	1000	–	HEP 170	Heat Sink Not Required
6	100	100°	1N3880	(HEP 153)
6	200	100°	1N3881	(HEP 153)

Table 3. Diode selection.

mica insulators and special means to provide insulation.

The Filter Capacitor

The filter capacitor smooths the pulsating dc and gives steady state dc with some percentage of ripple on top. I emphasize that fact that there is ripple on top since one of design criteria is that we can tolerate 10% ripple. If the wrong capacitor is chosen, the ripple may exceed 10% (if the capacitor is too small) and the output voltage may be too low causing the regulator to regulate poorly for heavy loads. If the capacitor is too large, the ripple will be smaller and the output voltage from the unregulated supply will be higher, but this is of little consequence to us. Thus, we have to determine the minimum size of the capacitor. Note that excessively large filter capacitors can cause enormously large surge currents through the diodes during turn on. Most silicon diodes can handle large surges for an instant or two so this shouldn't be too much of a problem. If the designer sticks close (50% to 100% larger) to the value of capacitance determined as per this article, problems should not be encountered with popping diodes.

To determine the proper capacitor, it is necessary to first determine the load resistance. This load resistance is determined by the formula $R_{load} = E_{out}/I$, where E_{out} is the output voltage we need from the unregulated dc supply in order to supply E_{reg}. I is the maximum current to be drawn. Note that "load" includes power dissipated in the regulating circuitry. In our example $E_{out} = E_{rms} = 18.9$ volts (theoretical E_{rms} was 16 volts, but we use three transformers to give us 18.9 volts) and I was 6.5 Amps. Thus $R_{load} = 18.9/6.5 = 2.9$ Ohms. The basic formula to be used for the value of the capacitor is $2\pi f R_{load} C=5$, where $\pi = 3.14$ and f = the line frequency. C is the desired capacitance in farads. Solving the equation for C we get $C = 5/(6.28 f R_L)$. In our example the line frequency is 60 Hz and $R_L = 2.9$ Ohms. Thus $C = 5/(6.28 \times 60 \times 2.9) = .0046$ or 4,600 uF. Since 4,600 uF is not a stock value, the next higher value would be used. The voltage rating of the capacitor should be at least double the E_{rms} voltage which in our case is 38 volts.

Some purists may question the 10% tolerable ripple figure previously given. This

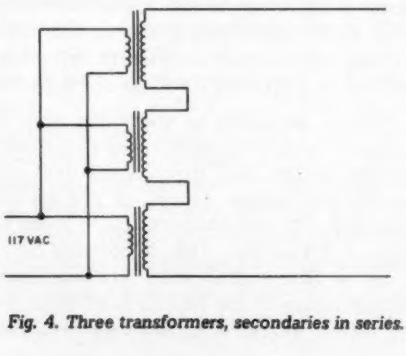

Fig. 4. Three transformers, secondaries in series.

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is understandable since for tube type power supplies "no ripple" was tolerable. While this 10% figure may seem like a lot, remember that the only thing that the 550 regulator cares about is that the lowest dc input voltage is at least 3 volts above the regulated output voltage. The amount of ripple on top of this minimum dc input voltage is insignificant as long as maximum ratings are not exceeded.

The Regulator

The NE550 regulator is an operational amplifier with internal reference voltage and current limiting capabilities. The operational amplifier compares an internal standard reference voltage (internal zener) fed into the non-inverting input with a sample of the desired regulated voltage. The difference between the standard voltage and a sample of the regulated output is amplified and inverted producing a control voltage. This control voltage controls a pass transistor which is in series with the regulated output. As the regulated output drops, the control votage increases which in turn causes the regulated output to increase. A stable point is eventually reached where the output voltage remains constant. This stable point depends on the ratio of two resistors (R_A and R_B in Fig. 6) connected as a voltage divider to deliver a sample of the regulated output to the inverting input of the operational amplifier. By changing the ratio of the values of the two resistors, the output of the voltage divider changes which in turn produces a change in the regulated output. The value of the regulated output, thus can be simply changed by altering the ratio of the values of two resistors. Table 1 gives various values of R_A and R_B for selected values of regulated voltage.

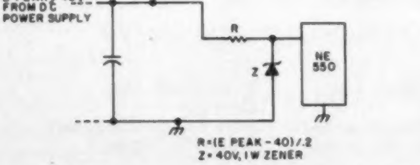

Fig. 5. Regulator protective circuit, E peak 40 V.

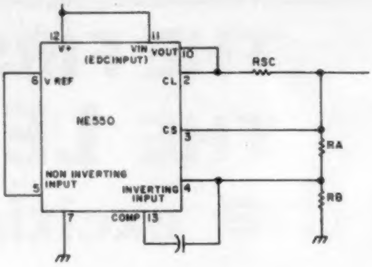

Fig. 6. NE550 regulating circuit.

Current limiting is provided by connecting a current sensing resistor between the base and emitter of a transistor as shown in Fig. 7. When a current through the current sensing resistor reaches the value of I_{lim}, the value of current at which to limit the current, a voltage of .64 volts appears across the emitter-base terminals of the limiting transistor. This limiting transistor starts to conduct and causes the base voltage on an internal pass transistor to be lowered. Since the base voltage of this internal pass transistor is lowered, the output voltage from the regulator is lowered. The output voltage does not drop to zero when I_{lim} is reached, but is merely lowered the right amount needed in order to maintain the output current at I_{lim}. The output current is not shut off but stays at the value of I_{lim}. When the load resistance increases to a point where the output current can fall below I_{lim}, then the output voltage goes back to E_{reg}. This is a very important concept to understand, because if I_{lim} is set at or below the current that the load draws, then regulation will be lost. For example, assume that I_{lim} is set at 6.5 Amps and that the regulated supply was designed for use with a two meter SSB transceiver. The output of the regulated supply is 12 volts and the average current drawn by the SSB transceiver is 4 Amps. An SSB transceiver by its nature can draw very high peaks of current and it is not unreasonable to assume that on current peaks the transceiver might draw 10 Amps of current. On voice peaks with I_{lim} set at 6.5, the current limiting will prevent the SSB transceiver from drawing more than 6.5 Amps. The only way that it can do this is to reduce the output voltage,

MFR	#	Cooling Capacity (Thermal Resistance)
Thermalloy	6111B	10°C/W
"	6176B	4
"	6401B	2.3
"	6403B	1.5
"	6421B	1.0
"	6441B	.54
"	6690B	.28

Table 4. Heat sink selection.

destroying regulation. It is possible that on voice peaks only 6 or 7 volts would be delivered to the transceiver. Low voltage will in most cases adversely affect the operation of any piece of gear and in some cases can cause damage. It is important to understand that *current limiting protects the power supply,* not the equipment. If it is necessary to protect the equipment from low voltage as well as over current, then a detecting circuit must be employed to shut down and latch the voltage off when over current is detected. This type of circuit will be the subject of another article.

To select a given regulated voltage, R_A and R_B must be chosen according to the formulas:

$$R_A = \frac{2000}{1.63} E_{reg}$$

$$R_B = \frac{2000\,E_{reg}}{(E_{reg} - 1.63)}$$

In our example where we want an output voltage of 12 volts:

$$R_A = \frac{2000}{1.63} \times 12 = 14{,}700\Omega$$

$$R_B = \frac{2000 \times 12}{(12 - 1.63)} = 2{,}310\Omega$$

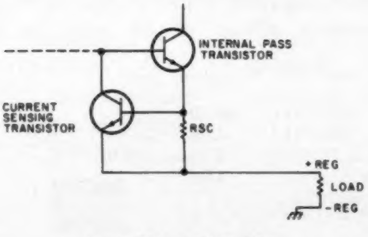

Fig. 7. Current limiting.

The value of the current limiting resistor is determined by the equation $R_{SC} = .64/I_{lim}$ where I_{lim} is the value of current at which to limit. In the power supply in the example, I_{lim} = 6.5 Amps which is the basic design value of the supply. Thus $R_{SC} = .64/6.5 = .1$ Ohms (approximately).[4]

From a practical standpoint it is not always possible to obtain precision resistors in the values you want without having to resort to ordering from mail order houses. While adjustment of the regulated output voltage may be achieved by using the circuit in Fig. 8 instead of two fixed resistors, the fixed resistors provide convenience and greater reliability over a circuit where a potentiometer may be jarred or mis-set by inexperienced personnel. (Fixed resistors will also keep twiddlers from "increasing the output by increasing the voltage." ZAP!) Five percent tolerance resistors may be used in place of the one percent resistors normally required for precise voltage determination. Table 1 gives the value of 5% resistors to be used for selected voltages. When using 5% resistors, a trimming resistor as shown in Fig. 9 should be used. The value of this trimming resistor is also given. Every power supply could be constructed as shown in Fig. 8 to provide adjustability over the entire range, but it is safer to limit the adjustment to a fraction of the entire range to prevent possible misadjustment into a voltage region which could possibly cause damage to the equipment being powered.

One percent resistors are handy to use when building a batch of supplies since the resistors can be installed without a trimming resistor and adjustment is not required. Table 1 also gives the values of one percent resistors required for selected voltage. These 1% resistors can be obtained from Allied Electronics.

The formulas given for R_A and R_B have been derived for optimum temperature stability of E_{reg}. With very little sacrifice at all in this regard, the basic regulating circuit may be made into a variable voltage regulating supply. Notice that in Table 1 the variation of R_B is small over the range of 10 volts to 40 volts. If we assume that R_B is a constant over that range and that R_A is a variable, we can make a variable voltage supply. Note that we can select a potentiometer to permit voltage variation over the whole range of the device from 2 volts to 37 volts, but the temperature stability at voltages of less than 10 volts will not be as good as the temperature stability in the range above 10 volts. Fig. 8 shows the circuit for a variable voltage supply. One unique thing about variable voltage capability is that the current limit stays the same over the entire range. I_{lim} is not dependent on the value of regulated voltage, but is dependent only on the value of R_{SC}.

---

[4] .1Ω resistors are available from VHF Engineering. If other low values of R_{SC} are required, use series and parallel combinations of .1Ω resistors to give the desired value.

It is possible to switch different R_{SC}, current sensing resistors, in and out of the circuit; however, from a practical standpoint problems arise. Switch contacts have resistance (both in a clean and dirty state). This resistance will become a part of R_{SC} and will affect the value of I_{lim}, making I_{lim} smaller as resistance increases. In addition, the contact resistance may vary from one switch cycle to the next causing I_{lim} to vary. A potentiometer conceivably could serve the purpose, but potentiometers also get dirty and very low resistance potentiometers are extremely hard to find.

The basic regulator circuit by itself as shown in Fig. 6 would not handle the current of 6.5 Amps required in our example. The basic circuit would only handle 150 mA. In order to handle additional current, the circuit in Fig. 10 would have to be used. This circuit uses an external pass transistor to control the higher current. This transistor is selected by choosing a transistor with sufficient current carrying capacity and sufficient dc current gain. In our case the current carrying capacity must be 6.5 A minimum. The dc current gain can be obtained from the formula:

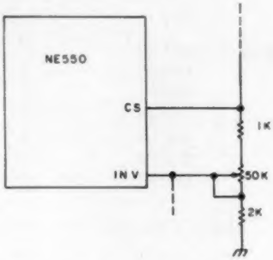

Fig. 8. Variable voltage supply.

$$\text{Current Gain} = \frac{\text{Output Current}}{.15}$$

The dc current gain can be found in Table 2 under the heading h_{FE}. Note that h_{FE} is usually specified for a particular current. This specified current may not be the value as the design current of the supply; thus, h_{FE} is really an approximation for most purposes. This approximation should cause few problems if the transistors in Table 2 are used. In our case the required current carrying capability is 6.5 A and the dc current gain required is given by current gain = 6.5/.15 = 43. Our minimum requirements for a pass transistor would then be 6.5 A and a gain of 43. The voltage rating should be at least 2 x E_{rms}, or 38 volts.

In addition to h_{FE} (dc current gain) and maximum current it is necessary to consider the heat dissipation of the device. The maximum dissipation of the pass transistor under working conditions may be estimated by the formula $P_{dis} = (E_{rms} - E_{reg}) \times I_{lim}$. For the example we are considering P_{dis} = (19-12) x 6.5 = 46 Watts. It is not unreasonable to use a 25% safety factor for the power dissipation, so the required power dissipation for this transistor would be 46 + 1/3 x 46 = 61 Watts. The minimum requirements for our pass transistor would thus be 61 Watts dissipation, 6.5 Amps, h_{FE} of 43, and maximum voltage of 38 volts. To give

Current	Voltage	Distributor	Part #	Approx. Cost
3 A	12.6 V	Radio Shack	273-1511	$4.29
2 A	25.2 V	Radio Shack	273-1512	4.29
6.6 A	6.3 V	Verado		3.75 ea., 3/$10
2.5 A	30 V	M. Weinshenker		4.85
12 A	18 V	VHF Engineering		

Table 5. Transformer selection.

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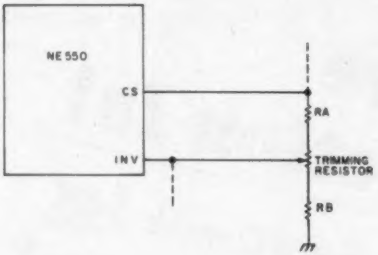

Fig. 9. 5% R_A, R_B with trimming resistor.

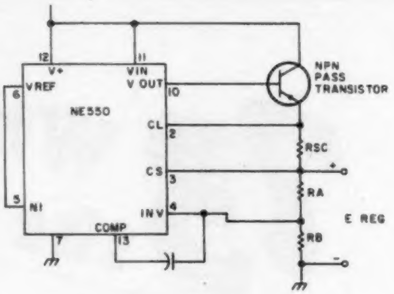

Fig. 10. NE550 driving external pass transistor.

yourself maximum flexibility, a good manual which lists transistor characteristics is handy (but not required). I have been using the Motorola *Semiconductor Data Library* available for $6.50 from Motorola. If you don't have a good book listing transistor characteristics, then you may use Table 2. Using Table 2 we find that a 2N6355 is suitable since it exceeds the specifications needed for this application. The 2N6355 costs less than $4.50, has a dissipation of 150 Watts, 20 Ampere current rating, h_{FE} of 500, and maximum voltage of 40 volts. Note that this transistor is a high gain Darlington transistor and was chosen for the table since it is readily available. It is wise to stay away from transistors with extremely high gains since these "hot" transistors can sometimes go into oscillation all by themselves.

The above calculations assume that the supply will handle intermittent shorts. If the supply must handle continuous shorts, then $P_{dis} = E_{rms}/I_{lim}$. At this point, the power supply design as shown in Fig. 10 is complete except for considering the heat sinking requirements.

Heat Sinking

As everyone knows, semiconductors dissipate heat and in some cases get very hot to the touch. But just how hot can semiconductors get without being destroyed? The data sheets for both diodes and transistors give power derating factors for reducing the allowable dissipation or allowable current for a given temperature rise. These factors must be used to prevent overheating and burnout of the device. Note that a power derating factor is a multiplier based on temperature which serves to lower the power rating as the temperature of the device increases. Table 2 gives derating factors for selected transistors.

Let us assume that in this power supply we used 100 volt, 6 Amp diodes such as the Motorola 1N3880. To determine the power dissipation of the diodes use the empirically derived formula $P_{diode} = I \times 1.5$; thus for our example $P_{diode} = 3.25 \times 1.5 = 5$ Watts (approximately). Furthermore from Table 3 we find that the maximum usable temperature without derating is 100 degrees centigrade.

At this point we must determine the cooling capacity of the heat sink needed. Heat sinks are rated in degrees centigrade per Watt. In other words, for every Watt of dissipation, the temperature of the heat sink will rise so many degrees centigrade above ambient room temperature (23 deg. C). If a given heat sink is rated as 10 degrees C/Watt, then the temperature of the heat sink will

Capacitance	Voltage	Distributor	Approx Cost
1000 uF	25 V	James	$ .75
6100 uF	50 V	Allied	5.00
25,000 uF	40 V	VHF Engineering	

Table 6. Capacitor selection.

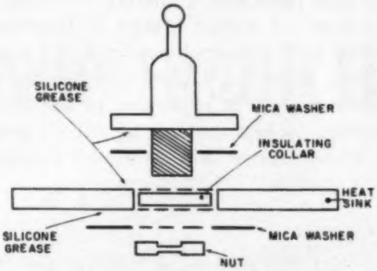

Fig. 11. Mounting diodes to heat sink.

rise 10 degrees for every Watt dissipated. The formula for determining the cooling capacity of the heat sink needed is:

$$\text{Cooling cap (deg C/Watt)} = \frac{(\text{max temp - ambient})}{\text{Watts diss.}}$$

From the table, the maximum temperature without derating is 100 deg. C. While our actual dissipation will be 5 Watts, a 25% safety factor applied to 5 Watts gives 6.25 Watts or 7 Watts (rounded upward). Using the formula above, Cooling cap = (100-23)/7 = 11 deg. C/Watt. Table 4 gives various heat sinks selected according to various cooling capacities. As can be seen, the Thermalloy #6111B might be used. This heat sink will produce a temperature rise of 10 degrees C/Watt. When selecting a heat sink keep in mind that the specifications of the heat sink must give *less* heat rise than the device. In other words, the degrees rise/Watt will be smaller or equal to the permissible heat rise of the device. Note that when mounting the diodes to the heat sinks that silicone heat conducting grease should be used on the diodes as well as the mica insulating washers as shown in Fig. 11.

VHF Engineering — Transformers, capacitors, diodes, power supply kits, regulator chips, .1Ω resistors, etc.
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Verada — Transformers.
Poly Paks — Diodes, regulator chips.
Note — Prices and availability will change from time to time. VHF Engineering manufactures power supplies and will sell individual components to experimenters with no minimum order.

Table 7. Additional sources for parts.

As previously determined the transistor chosen will dissipate 61 Watts under the conditions defined. In order to determine the amount of heat sinking required it is necessary to determine the maximum permissible device temperature rise for a dissipation of 61 Watts, the maximum dissipation that we previously calculated. If you have access to charts, this temperature rise is easy to find. In the absence of charts, the derating factor given in Table 2 is used. The derating factor is a factor that tells us the reduction in wattage which must be applied against the maximum wattage as the temperature rises. For example, for the 2N6355 the derating factor is 1.2 Watts/Deg. C. Thus for every degree centigrade above room temperature, the wattage must be reduced by 1.2 Watts. As the temperature rises, the power dissipation decreases. This factor can be used to determine the maximum permissible device temperature rise. This temperature rise is determined by the formula:

$$\text{Temp rise} = \frac{(\text{maximum wattage} - \text{required wattage})}{\text{derating factor}}$$

Thus in our example, the maximum wattage is 150 Watts, the required wattage dissipation is 61 Watts, the derating factor is 1.2 W/deg.C, and

$$\text{Temp rise} = \frac{150\text{-}61}{1.2} = 74 \text{ degrees rise.}$$

In this case, as long as the temperature of the device does not increase by more than 74 degrees, we will be operating within safe bounds. Note that we are talking about a temperature rise in this case, so in order to use the previous formula we would have to add the ambient room temperature to get the maximum temperature, but then we turn right around and subtract the room temperature. Thus, the previous formula can be modified for cases where we are talking about "temperature rise" as follows:

$$\text{Cooling capacity} = \frac{\text{temperature rise}}{\text{dissipation (Watts)}}$$

In our example we have: Cooling capacity = 74/61 = 1.2 degrees C/Watt. The heat sink

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required must have a thermal resistance of less than 1.2 degrees C/Watt. A Thermalloy 6421B with a thermal resistance of 1 degree C/Watt would be a good selection in this application. It is important to use liberal coatings of heat conducting silicone grease on the transistor and associated insulating mica washers.

Summary

It is difficult in a brief article to go into every detail required in order to produce a correct and exact power supply design to fit a driven set of requirements, so the approach that has been taken with this article is to include substantial safety factors so that the analysis and arithmetic could be simplified. The author recognizes that lower rating components could be used, but then exact calculations and extensive analysis would be required. If the experimenter follows the design steps given in this article, the result will be a reliable, moderately priced power supply which most experimenters can easily build.

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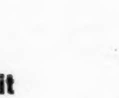

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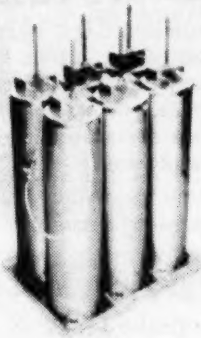

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39. 7.03R
40. 7.66T
41. 7.06R
42. 7.69T
43. 7.09R
44. 7.72T
45. 7.12R
46. 7.75T
47. 7.15R
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Digital Logic - Down Through the Months

Since their inception a few years ago, integrated circuits have had a great impact on the world of electronics. Many new logic types have been introduced, particularly digital, because they allow the designer much greater latitude in his choice of voltage and current levels than do analog devices.

This new technology has brought with it new terms and abbreviations which seem to have left a number of hams confused. In this article I will try to clear up this confusion by reviewing the popular types of IC logic families.

RTL

The first type of IC that came into general usage was resistor transistor logic (RTL). Its basic configuration is shown in Fig. 1. A high at one or both inputs turns on the corresponding input transistor which produces a low at the output.

It should be remembered that the circuits shown are not discrete components but rather are contained on a microscopic piece of silicon.

RTL has several serious shortcomings: (1) slow speed with a maximum of about 10 MHz; (2) low fan out, that is, one output can drive only a few inputs, and (3) poor noise immunity. Because of these deficiencies almost all of the RTL ICs being produced today are for replacement. If you happen to run across any RTL ICs they will probably be from either the 900 or MC700 series.

DTL

Next on the scene was diode transistor logic; its basic gate is shown in Fig. 2. A low at one or more of the inputs forward biases that input diode, causing the diodes connected in series with the transistor base to go into a nonconducting state; the transistor turns off and the output goes high. DTL never was widely used as it soon evolved into an improved type of logic called TTL.

TTL

Before delving into TTL, let's first take a look at transistor switching speed. If we apply 0 volts to the base of a transistor there will be almost no charge carriers in the base and the transistor is off. As we increase the base voltage the number of charge carriers in the base increases and the transistor begins to conduct. Finally we reach saturation where there are a large number of charge carriers in the base, the collector to emitter voltage is very low and the transistor is fully on. Switching speed, then, is determined by how quickly we can get these charge carriers into and out of the base.

Transistor transistor logic is shown in Fig. 3. Its input functions like DTL with the base emitter junctions acting as the input diodes and the base collector junction as the base diodes. The difference arises during turn-off, when the transistor action of Q1 reduces the charge carriers in Q2 more rapidly than would a diode. A further increase in speed

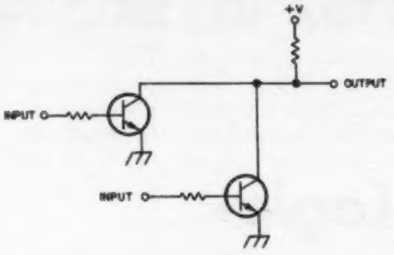

Fig. 1. RTL gate.

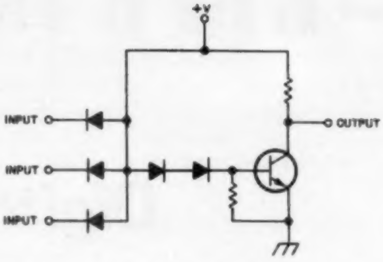

Fig. 2. DTL gate.

results from the totem pole output where the transistors are always in opposite states. These transistors change state whenever the output switches, increasing the turn-on or turn-off current to the next stages.

The maximum speed of TTL is about 15-20 MHz, although selected devices may go higher. Because it is better suited to integration techniques than RTL, the circuit complexity of each IC can be increased.

The 7400 series of TTL ICs are widely available and are the most inexpensive ICs on the market today. One good example of the use of TTL is the K2OAW frequency counter.

Schottky TTL

A Schottky TTL gate is like a standard TTL gate with the exception that each transistor has a Schottky diode connected across it as shown in Fig. 4. This diode reduces the number of charge carriers in the base when the transistor is on. Less time is needed to deplete the base region of carriers and to turn the transistor off. This results in switching speeds of 50 to 60 MHz.

Most Schottky TTL gates are of the 74S00 series. They and DTL are compatible with conventional TTL: No interfacing is needed.

ECL

Emitter coupled logic is the fastest logic available today. It carries the non-saturated idea of Schottky TTL even further. A basic gate is shown in Fig. 5.

An important thing to remember when discussing ECL is that when a transistor is in the active or forward biased region the emitter is about .7 V more negative than the base. A voltage of −1.3 V is applied to the base of Q3, putting it in the active region and making the emitter voltage −2 V (−1.3 V − .7). If the inputs are held to say −1.5 V (low), Q1 and Q2 will both be reverse biased and off. This turns Q4 on producing a low at output 1. Q5 is off and output 2 is high. If we now apply −.7 V to either or both inputs, that input transistor(s) will go into the active region, the emitter voltage will rise to −1.4 V (−.7 − .7) and Q3 is reverse biased, turning it off. Both the outputs will then change state. Note the small voltage swings used: The transistors are off or barely into the active region.

The big advantage in using ECL is speed; rates of over 1 GHz have been obtained. The sacrifice we make for all this speed is power. ECL consumes roughly 3 to 4 times more per gate than TTL. Because of this, ECL use is limited to high speed applications such as large scale computers and frequency counter prescalers. Although rarely available from surplus dealers, the MECL 10000 series is the most common.

MOS

All of the ICs we have discussed so far have used bipolar transistors; let's now look

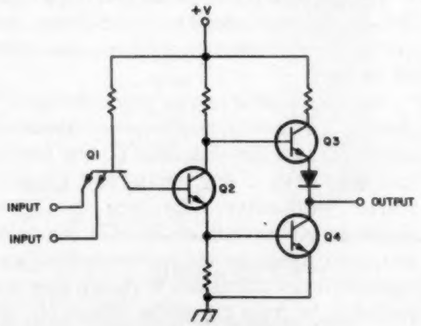

Fig. 3. TTL gate.

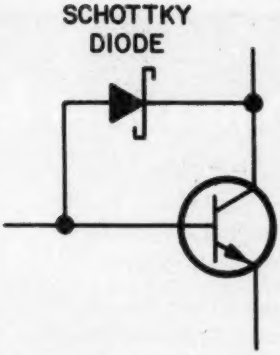

Fig. 4. Transistor with Schottky diode connected across it.

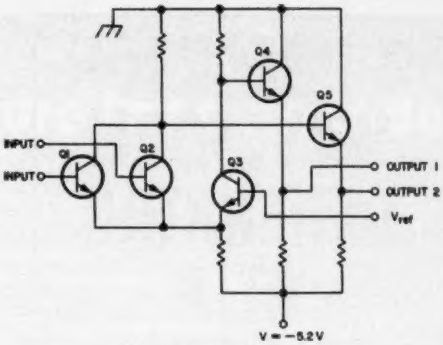

Fig. 5. ECL gate.

at ICs that use MOSFETs (metal oxide semiconductor field effect transistors). In Fig. 6(a) the output is high unless both inputs are high, which pulls the output to ground. In Fig. 6(b) a high at either input turns on the input transistor and grounds the output.

Because of the simplicity of the MOS circuit (only a few transistors are used), and the fact that a MOSFET can be made smaller than a bipolar transistor, MOS's claim to fame is density. Calculators and memories (up to 4k now) are two uses. The 1103 is quite famous as it was the first large (1k) IC memory and made computer manufacturers consider replacing their core memories with ICs. However, the 1103 requires some very critical timing sequences, and should be avoided by the amateur.

MOS also exhibits low power consumption, but its shortcoming is speed, 2 to 5 MHz. That figure, though, is certain to improve with new designs and in fact several manufacturers have announced faster models.

Unless otherwise stated all the large (256 bits or more) memories and shift registers you see advertised in 73 are MOS.

CMOS

Complementary metal oxide semiconductor ICs were originally developed for the military, and since have become very popular in the industrial market. CMOS is slow but uses very little power. As shown in Fig. 7, CMOS contains both N and P channel MOSFETs. A high at the input turns Q2 off and Q1 on, forming a low at the output. With a low input, Q2 is on and Q1 off, resulting in a high at the output. In both cases the resistance between the power supply and ground is very large as Q1 or Q2 is always off. The only time CMOS draws more than negligible power is when it changes state. The low power consumption of CMOS is significant at low frequencies but disappears as speeds of 1 to 2 MHz are reached. The speed of CMOS can reach that of TTL if the gates are deposited on sapphire. Dubbed SOS for silicon on sapphire, this new family has not been produced in large quantities due to cost and the increasing speed of conventional MOS.

The noise immunity of CMOS is excellent. Also, it is unique in that it can operate over a wide range of supply voltages; typically, anywhere from 3 to 15 volts will do.

CMOS comes in three series: 74C00, CD4000, and MC14000. The logical functions of the 74C00 gates match that of TTL 7400 gates, but one type cannot be

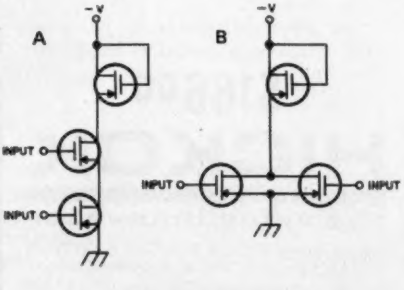

Fig. 6. Two MOS gates.

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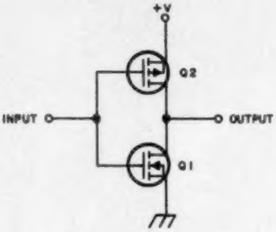

Fig. 7. CMOS inverter.

directly substituted for another. CD40XX and MC140XX ICs are equivalent pin for pin.

Back to Bipolar

It is interesting to note how integrated circuits have caused a complete turnaround in the world of design. During the early days of radio, when vacuum tubes were used, designers tried to keep the number of active elements to an absolute minimum. This held true, though to a lesser extent when transistors appeared. But with ICs, transistors are easy to make and passive elements like resistors are to be avoided. The early IC designs, RTL and TTL, seem to be merely an extension of discrete circuits employing many resistors. Later, MOS was developed using only transistors, resulting in denser and more efficient ICs.

Bipolar designers looked at MOS and found they could apply MOS ideas to their ICs. The first of this new breed of transistor only bipolar ICs is called integrated injection logic (I^2L), which its makers claim has an excellent speed to power consumption ratio. The first uses of I^2L are in microprocessors (brains of a computer) and watch circuits. Also in development are other bipolar types such as C^3L, CHIL and SIL. As they become available, these new bipolar types will probably cause TTL to decline in importance and will replace MOS in many designs.

Integrated circuit technology is still quite young and merits close attention. There are, I am sure, many new developments yet to come.

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Reference

A Modern VHF Frequency Counter, Peter A. Stark K2OAW, *73*, May, July, September 1972.

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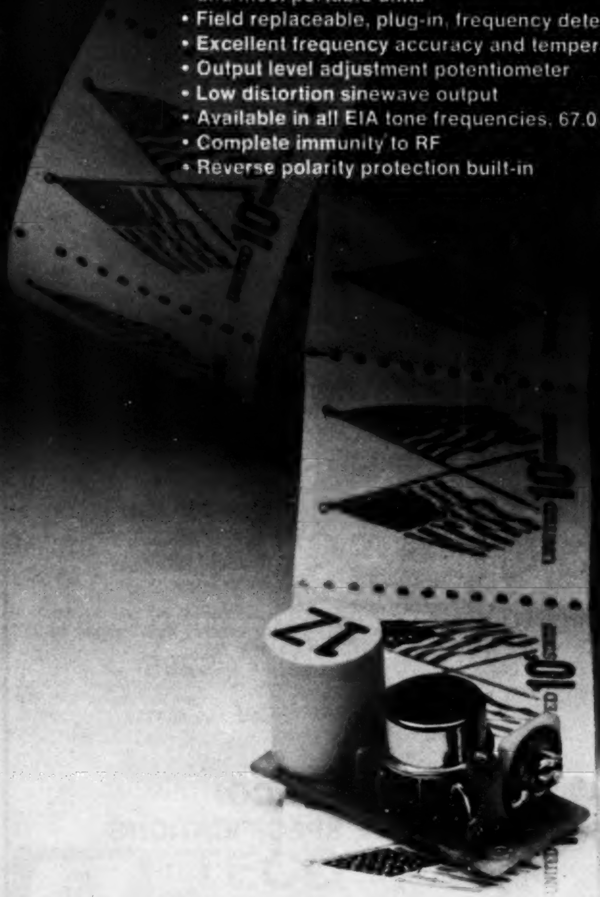

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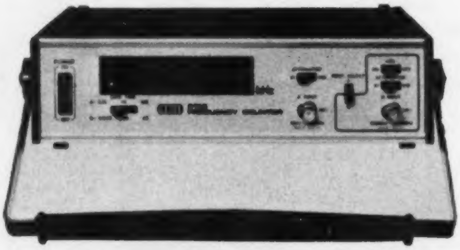

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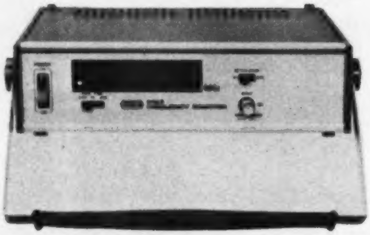

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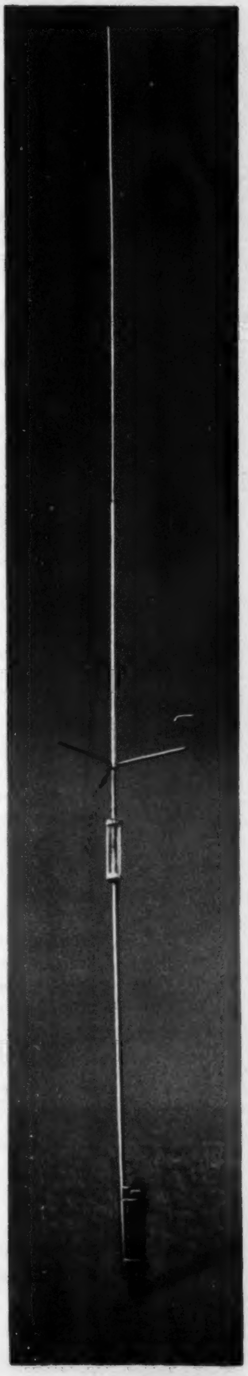

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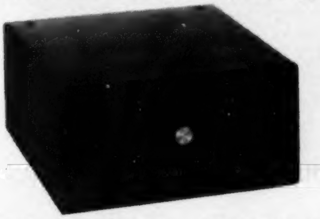

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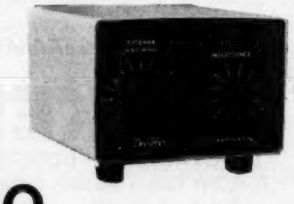

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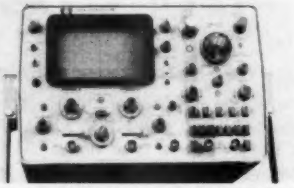

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Looking West

Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

Madison Avenue must think that I am some sort of filthy slob, since every other commercial I see on the boob-tube seems geared to convince me that the rest of society will not accept my presence unless I shower with this brand of soap, spray myself with that brand of deodorant and brush my teeth with some super-duper toothpaste. I hate to disillusion all those egos back on Madison Avenue, but though they believe it or not, I think I am a bit more intelligent than the average 10 year old child and do have the ability to decide what I want to purchase without their rather tasteless attempts at convincing me that I am wrong . . . that what they are pitching is far superior to what I prefer. This for me holds true in anything I purchase, be it for my personal use or that of the family.

I judge a product by performance and cost, not by how well some ad agency has done in pitching it. With everything costing more and more each day, I have, like many of you, become a "price buyer"; I look for the best bargain and have found that in many cases the less touted product seems to surpass the more heavily touted one. I guess that this whole thing ends up to me being tired of being bombarded with ad after ad on TV for things that I could care less about, and a rationalization as to why I do what I can to support the public access media — maybe not as much as I wish financially, but at least giving it a plug in this column from time to time. There is nothing on the tube to match the overall creativity that is presented uninterrupted, and, in the field of children's entertainment, I have yet to see anyone else come close to CTW (Children's Television Workshop). If I am going to watch TV for an evening, I far favor the non-commercial kind to the commercial variety. Try it yourself some evening; forego that well touted spectacular with its well touted sponsors for an evening with commercial free television and then let me know how you feel. I know how I feel.

So much for the media soapbox; now back to the amateur radio soapbox and a continuation of where we left off last month, covering events on .76 up until July 9th or 10th. I am happy to report that the malicious interference to WR6ABN has gone bye-bye, but my feelings toward the persons or person responsible for it remain the same: The perpetrators are naught more than malcontents within the amateur radio community and therefore in my mind have forfeited their right to be called "Brother or Sister Ham". I still feel that, for the good of the amateur service, they must be exposed for what they are so that the next person considering such action will think twice. I can hack a lot of tripe, but expanding a bad situation through the use of willful and malicious jamming, expanding a confrontation to include people who are users of a given repeater, in this case WR6ABN, and caring less about what transpires on .76 is a sickening and thoughtless transgression on the rights of ABN's user populace. In a similar vein, the same holds true for WR6AKC, since no matter how you look at it, its sole purpose was to play havoc with AJL. AKC, thankfully, has gone away.

The latest in the situation of WR6AJL itself is that it will continue to operate, but not on .16-.76. While still unconfirmed at this time, the most recent information has it that AJL is vacating .76 and will be moving to 147.75 in/147.15 out; in other words, as a .16/.76 repeater, AJL has failed. More important than the fact that it has failed are the reasons why. While there will be many discussions both on and off the air covering this topic, including many differing views, I rather think that the answer is obvious. It was not the anti-AJL action on the part of the .76 simplex operators or the stand of the SCRA that was responsible, but simply the fact that AJL did not garner the necessary support in user populace that was necessary for it to survive and prosper. If, in fact, it had been able to have its usership multiply quickly, I suspect that it might have been able to prosper, even with all the hell that was thrown up against it. Whether it was because of apathy or just plain uninterest on the part of the Southern California two meter FMers, it never was able to obtain the support necessary in the form of ongoing day-to-day, hour-to-hour usership, and for the moment, the uneasy status quo that was .76 before AJL has returned. But for how long?

True, AJL has failed, but sometime in the future unnecessary confrontations such as this are bound to arise once more. Some other group or individual will get the bug to see that this area does indeed have a .16/.76 and/or a .34/.94 repeater, open for all to use, and again we will go through the same kind of panic situation. That is, unless action is taken now to remedy this situation. Possibly the best remedial action possible would be the establishment of repeaters on one or both of these channels, operated by those parties which have the vested interests in those channels. A .16/.76 repeater operated under the auspices of the simplex users group could serve the purpose of providing repeater type operation when necessary, and, at the same time, .76 could be used for simplex when a repeater was not of a necessity to extend communication range. Use of a lock-out receiver and "quiet hours" for the system during the major morning and evening commute times could write a final "The End" to a situation that will only keep reoccurring as times go on — a situation that only makes enemies out of amateurs who in reality should be friends. No, this idea is not mine; it's more of a summarization of a number of discussions between simplex people that I have listened in on, and in my mind is a reasonable alternative to an ongoing struggle between the relay and non-relay factions of the Southern California FM community. Let's see what the future brings . . .

As you may have noted in reading LW during the past few months, the .16/.76 vs .76 simplex controversy was not the only problem of significance in this area, although it has been by far the most boisterous. If we must discuss problems, and that seems to be the thing these days, then the one of unsanctioned, uncoordinated repeaters deciding to jump an already assigned channel is a definite paramount issue. Simply, even with the inverted split-split channel pairs in use, Southern California is just about out of space on two meters for new systems. Yet, week after week, the SCRA Technical Committee receives applications for frequency coordination on two meters. I don't know the

Continued on page 148

BE MY GUEST

from page 6

HIGGINBOTHAM: I don't believe any of the Commissioners have CB. But we have quite a few employees who have citizens band. It varies from very bad to very good, depending upon where you are and what channels you have to listen on.

BOURNE: *Is the FCC planning on preventing CB dealers from selling Amateur transceivers such as Yaesu that cover 11 meters with over 200 watts to CBers? This is quite a common problem.*

HIGGINBOTHAM: I know it is. I think one of the things that's going to happen is the (FCC's) next step — and I admit that this is not a step I like to take, because I don't think always the answer to solving problems is more rules. But we have so many people who are attempting to find ways to operate outside the intent of the rules that we are going to have to go to type acceptance of amateur equipment. If that happens, I think that Yaesu is going to have to modify its units. I just feel that any standard we adopt (should not allow type-acceptance of) any unit with 11 meter band labeled on it.

BOURNE: *Doesn't type acceptance of amateur radio equipment almost defeat the Amateur Radio Service concept of "building your own equipment"?*

HIGGINBOTHAM: As we envision type acceptance of Amateur equipment, it would be applied only to commercially available Amateur gear. That would be only as manufactured by manufacturers, which permit Amateurs to make changes. I think it would probably mean that you would get better equipment. It probably is going to mean that, for example, some Amateur linears or power amplifiers are going to have filters which will not permit their use on any of the Class D channels. But that may add a little to the cost. I do believe there are a large number of manufacturers out there who build devices and they get by under the fact that they can be sold legally to the Amateur market, but they do not advertise them in legitimate Amateur trade journals. They advertise them in CB journals and truckers' magazines. They do throw in a little caveat, "Not legal on 11 meters," but to me it's just a blatant invitation to citizens banders to buy their equipment, and that's the only market they have. And we're going to clean that up, I'm convinced of it.

BOURNE: *I sure hope so. But what disturbs me most about what is happening on CB is what it's doing to the vital Amateur Radio Service. In other words, the potential Novice is not going into Amateur Radio — he is going into CB because he can just run down to his local (CB equipment store), buy a radio, not even bother getting a license, plug it in, and he's on as a hobbyist. (Using CB as a hobby is illegal, according to Section 95.83(a) (1) of the FCC rules.) In high schools, for example, you no longer find large groups of Amateurs; instead, you find larger groups involved in CB illegally, as a hobby. All over the country, young people are missing out on such a vital hobby (as Amateur Radio), that can trigger their interests toward getting electronics engineering degrees, for example. But all they are learning now is how easy it is to break FCC rules and regulations.*

HIGGINBOTHAM: I know that's a problem. I don't quite know what the answer is. I think it's beyond the realm of possibility to expect us to institute some kind of exam procedure for CB . . . with the large number of applications we are now receiving per month.

BOURNE: *What is it per month now?*

HIGGINBOTHAM: I think last month (May) there were about 190,000 good applications. The month before there were about 140,000. We get over 200,000 pieces of mail in our Gettysburg office every month.

BOURNE: *How much of a backlog is there now in opening mail?*

HIGGINBOTHAM: I think it's about 16 or 17 days. That's too long. We would like to open mail the day we receive it. If we receive a late delivery, open it the next day.

BOURNE: *Do you think establishing a point-of-sale license might clear that up?*

HIGGINBOTHAM: No.

BOURNE: *Are you planning on pursuing that any further?*

HIGGINBOTHAM: We would like to have some sort of a procedure that would permit an off-the-shelf type customer to begin operation quickly, if we can. That kind of a procedure, whether you call it point-of-sale or some kind of conditional or interim license, will not solve our application backlog, because applications will still have to come in and will still have to be processed. That can only be solved by manpower in our present state. We feel that we made a lot of changes; we've reduced, almost an irreducible minimum, the amount of information we ask for on applications. At the present time, we get out of our processing staff about 50,000 applications per man year of effort. That means an average application is in an examiner's hands about two minutes. We are still looking at other procedures we can utilize to update efficiency, but I don't think that we are going to be able to make a real dent there. So we have two separate problems. One of them, giving someone an immediate operating authority, is a public-service type of thing. We think it's in the public interest to serve people quickly who want to be licensed. On the other side of it, the manpower is related to that, but I don't think it's very realistic to gear up enough people to process 200,000 applications a month, on a two- or three-day turnaround basis, which would be highly desirable.

BOURNE: *Jumping back to ATIS — since that would use an ASCII-type of transmission system which you would have to monitor, are there any plans to further the allowance of ASCII on Amateur Radio for radioteletype transmissions? The Commission denied a request a few years ago for ASCII privileges, due to the fact that it could not justify to the public the purchase of monitoring equipment for ASCII transmissions from Amateurs.*

But now that ATIS might be established with ASCII, and the Commission therefore would have to have ASCII monitors, this reason would no longer be valid. So are there any plans to allow this?

HIGGINBOTHAM: I think we may have a petition renewing that request. (The American Radio Relay League recently submitted such a petition.) We are going to have to take another look at that. As I envision ATIS, if we get ATIS, we are insisting upon a standardized system on the theory that we would have a standardized readout device. It would probably be a Nixie-tube or LED display type of unit which is designed to work on just the call letter. You might also have to include provision to handle the unit number because, if we go to ATIS, I'm sure that users will want, in addition to call letters, a unit identifier. I think, in the case of Amateur Radio, that that turndown was based upon our inability to monitor the text. I don't think that's going to be changed by ATIS. It will have limited digital readout capabilities. I would assume that we are going to have to have those devices specially built, initially.

BOURNE: *ASCII, if it's done correctly, would not take up any additional bandwidth, and would allow for much more experimentation on Amateur Radio, which is what the service is all about.*

HIGGINBOTHAM: I'm not really that hung-up on prohibition of ASCII . . . (just because) we cannot decode the text. As a practical matter, if you really want to read it, you can record it; it's laborious, but you can do it manually.

BOURNE: *On the RACES docket, is anything going to happen in the near future?*

HIGGINBOTHAM: If you looked at any of the comments, I think you would appreciate it was a touchy proposal. I had one serious concern about it. I think that there has been a widespread growth of abuses of Amateur Radio by local governments, in their desire to get additional Local Government facilities, that has nothing to do with RACES programs. That concerns me, because I think that when that happens the Amateur community has been had. I think the Commission has not been dealt with fairly. That's been sort of held up. The chief of that branch has been vacant since John Johnston left it. We've been trying to find someone and it was recently posted. I think when we get that job finished this fall, we will pick up the RACES rulemaking and do something with it. Meanwhile, I consider some of the other items to be of more immediate importance, such as crossbanding rulemaking, and the matter of assignment of two-letter calls to the Extra Class. I think those matters will be addressed before we get to RACES.

BOURNE: *Is your staff up to full capacity now, in all the various branches?*

HIGGINBOTHAM: No. We are understaffed in a number of areas, but at the moment we are about, I think, one over our year-end ceiling. We have a normal employment level and a year-end ceiling level. At the moment, Amateur and Citizens is one position low, and the rest of our divisions are staffed at current authorized strength. We have one that is two over.

BOURNE: *Do you think that Class E CB will really take hold, considering*

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(the relative inactivity of) Class A on 460 MHz? Why would CBers suddenly want to go on 220 MHz FM? There is no long-distance "skip" to work there, that they are working illegally on 11 meters.

HIGGINBOTHAM: The same thing that has made Amateur repeaters go, on 2 meters. I think that there will be widespread multichannel equipment available at reasonable prices. I feel that if we have Class E there has to be some provision for repeaters.

BOURNE: *Who would run these repeaters?*

HIGGINBOTHAM: That raises a question as to how we would do it. They may be somewhat like the SMRs (Specialized Mobile Radio carriers) that we are talking about in Docket 18262. Or they may be club-type operations. I would think it could be done by clubs of CBers.

BOURNE: *But clubs are virtually groups of hobbyists. In other words, why would a CB group even form, since CB is supposed to be used as a tool? Can you really trust a group of hobbyists which shouldn't even exist in the first place to run a repeater legally? Or shouldn't it be some other type of setup, maybe even a new commercial service established to run repeaters for CB?*

HIGGINBOTHAM: Well, perhaps. One of the things that bothers me a little bit there would be creating something that might be regulated as a common carrier. Traditionally, that, in my opinion, hasn't worked all that well. It's beset with applications to deny, protests, and so on. Of course, we would envision there a shared service with no protection, so maybe it could work.

BOURNE: *Or do you think there might be so many takers for the new Communicator (proposed code-free class of Amateur) license, if this goes through, that there won't even be any need for Class E?*

HIGGINBOTHAM: That's one of the things we said we wanted to evaluate. My guess would be that we are not going to have a flood of Communicator licensees. I've heard at Amateur meetings someone walk around and say, "Count to three." When a person says, "Three," they say, "You've just passed the test for your Communicator license." The fact that we say "no-code Amateur" doesn't mean that we are not going to insist upon some sort of an examination to show knowledge in regulatory and operational and technical aspects of use of radio.

BOURNE: *What are some other current projects that you are working on?*

HIGGINBOTHAM: In Amateur and Citizens, we are very seriously considering handling Docket 20120 – CB expansion – in two parts. The first Report and Order will address the AM-versus-sideband issue, because we feel there are a lot of users that have to be told what we're going to do. We need to do something about changing the inter/intrastation designation. I think we are going to drop all designations of inter/intra frequencies. We will retain the emergency channel. The second part would be the availability of additional channels. Because we do have neighbors on the north and south of us, who are operating in the same band, I don't feel that we can go to a Report and Order until we work

Continued on page 144

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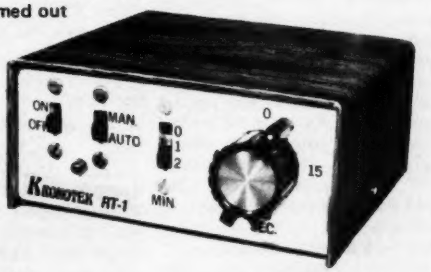

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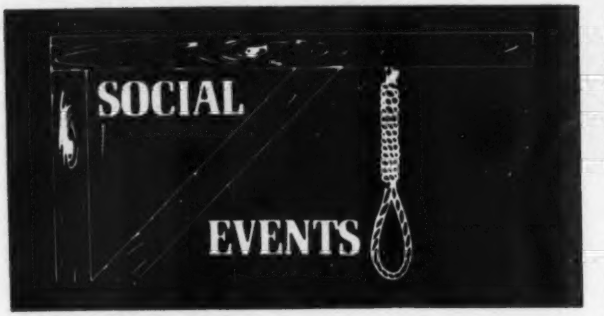

SOCIAL EVENTS

OTTAWA ONTARIO
OCT 3-5

The 1975 Radio Society of Ontario Convention, hosted by the Ottawa Amateur Radio Club, will be held at the Skyline Hotel, Ottawa on October 3, 4 and 5, 1975. Programs include: 9 technical forums (including W2NSD/1, 73 Magazine's Wayne Green), commercial exhibits, flea market, technical displays, C.R.C. satellite display, major drawings and door prizes, and much more. The Skyline Hotel is located within walking distance of Parliament Hill, National Arts Centre, the Royal Canadian Mint and in a major shopping area.

EAST RUTHERFORD NJ
OCT 4

The Knight Raiders VHF Club's auction and flea market will be held on Saturday, October 4th, at St. Joseph's Church of East Rutherford, Hackensack Street, East Rutherford. Free admission, free parking, refreshments available. Talk-in will be on 146.52 and 146.94. Flea market tables: $5 for full table, $3 for half table. Reserve your tables in advance by writing to The Knight Raiders VHF Club, Inc., K2DEL, P.O. Box 1054, Passaic, New Jersey 07055.

WAKEFIELD MA
OCT 4

Quannapowitt Radio Association annual auction, greatest and oldest in N.E., Saturday, October 4th, St. Joseph's Parish Hall, Wakefield, Massachusetts, 10 am to 4 pm, doors open 9 am, 10% commission, no minimum. Door prizes, special prizes. Talk-in 146.52.

MEMPHIS TN
OCT 4-5

Memphis is beautiful in October! The Memphis Hamfest, bigger and better than ever, will be held at State Technical Institute, Interstate 40 at Macon Road, October 4 and 5. Demonstrations, displays, MARS meetings, flea market, prizes. Talk-in on 3980, .34-.94 and MARS. Contact Harry Simpson W4SCF, Box 27015, Memphis TN 38127 or telephone 901 358-5707.

WARRINGTON PA
OCT 5

The Mt. Airy VHF Radio Club (the Packrats) are holding "Hamarama 75" at the Bucks County Drive-In Theater, Route 611 (Easton Rd), Warrington, Pa., on Sunday, 5 October 1975, 8 am to 4 pm. Registration $1.00, tailgating $2 – bring your own table. Parking for 1000 cars. Talk-in via W3CCX/3 on 52.525, 146.52 and 222.98/224.58 MHz. For information contact Lee Cohen K3MXM, 8242 Brookside Rd, Elkins Park, Pa. 19117. Phone (215) ME5-4942.

CEDAR RAPIDS IA
OCT 5

Cedar Valley ARC Hamfest. Commercial displays welcome. Advance tickets $1.50. Prizes are Icom 22A, Wilson HT, Collins 30L1 power amp, Cushcraft beams and many more. Overnight camping permitted. Talk-in 146.16/76,146.94 and 3.97 MHz. Advance reservations CVARC, Russ Boone, PO Box 994, Cedar Rapids IA 52401, (319) 393-1080 after 5 pm.

LEAGUE CITY TX
OCT 5

The Tidelands Amateur Radio Society's annual hamfest is Sunday, October 5, 1975, 9 a.m. 'til-? at the Galveston County Park, League City. Advance registration $1.50; $2 at door. Free parking, refreshments available. Main drawing for door prizes will be at 3:00 p.m. Swap booths available. For information, send a S.A.S.E. to Luke Sterling, 105 Seabreeze Drive, League City, Texas 77573.

NUTLEY NJ
OCT 6

The Nutley Amateur Radio Society will again conduct classes in Morse code and basic electricity and radio theory for prospective Novice class amateur radio operators. The first class will be held on Monday, October 6, 7:00 pm, in the Nutley Red Cross Building, 169 Chestnut Street, Nutley NJ. Interested persons should write to the Society or telephone the president, Noel Scheffen WB2LDN, at 201-661-2057.

PARMA OH
OCT 10

The Parma Radio Club of Parma, Ohio, suburb of Cleveland, will hold its first fall flea market on October 10, 1975. The time is 8 pm to 10:30 pm. The location is in the basement of the Cardinal Savings and Loan building, 5839 Ridge Road, Parma. The club is requesting a donation of $1.50 per person at the door. (Children under 12 free.) For more information contact John Thomas WB8JSC, President PRC, 3110 Grantwood Drive, Parma OH 44134.

COLUMBUS OH
OCT 10-11

On October 10 and 11, 1975, the ARRL Great Lakes Division Convention will be held in Columbus, Ohio. The actual site is on the north side of the Ohio State Fairgrounds just off 17th Avenue. There will be a number of well-known personalities among the amateur radio fraternity there both as guests and as speakers. For more information contact: Ira Bickham, Chairman, Industrial Displays, 1423 Thurell Road, Columbus, Ohio 43229.

SYRACUSE NY
OCT 11

The eleventh annual Radio amateurs of Greater Syracuse Hamfest will be Saturday, October 11, 1975, 9 am to 6 pm at the Syracuse Auto Auction, 4 miles south of Syracuse on U.S. Route 11 between Nedrow and LaFayette, New York. Exhibitors, flea market, CW and Wiring Contests, speakers, forums, panels and eyeball QSOs. Lunch counter, nearby campsite and Apple Festival for whole family. Talk-in on 31/91. Donation $2 at door – before October 1st $1.50. For more information contact Allan WA2UBT, 128 Atkinson Avenue, Syracuse, New York 13207.

WASECA MN
OCT 11

The 5th Annual Southern Minnesota Swapfest will be held on October 11, 1975 at the Waseca Community High School beginning at 9 am. It is southern Minnesota's largest hamfest. For more info contact VARS, Box 3, Waseca, Minnesota 56093. Sellers bring your own tables.

MITCHELL IN
OCT 12

The Spring Mill Hamfest will be held on Sunday, October 12, 1975 at Spring Mill State Park in Mitchell, Indiana with Hoosier Hills Ham Club, Inc. Flea market, IPON, IRCC, ITN. Major prize: Drake TR-4C, second prize: Drake TR-22C, pre-registration prize: TR-22C, bonus registration prize: TR-22C. Gus Grissom Memorial, plenty of playground and Bingo for XYLs & YLs. All registrations $2; State Park admission extra. Send your advance registrations to Hoosier Hills Ham Club, P.O. Box 375, Bedford IN 47421.

STOUGHTON MA
OCT 12

The Minute Man Radio Assoc. (M.M.R.A.) of Eastern Massachusetts will hold their annual auction Sunday, October 12, 1975 at Stoughton High School in Stoughton, Mass. at 12:30 pm. This event is rapidly becoming the largest of its kind in the area. Three skilled auctioneers will preside. Excellent prizes, quality food and snacks. Everyone welcome.

LIMA OH
OCT 12

The Northwest Ohio Amateur Radio Club Inc., will hold its Hamfest October 12, 1975 at the Allen County Fairgrounds in Lima, Ohio. 150 inside tables, manufacturer's displays, door prizes, dealer tables and free camping space Saturday night. Tickets advance $1.50 – gate $2.00. Talk-in 52/52, 94/94, rptr. 07/67. For reservations tickets, write: NOARC, PO Box 211, Lima OH 45802.

GAITHERSBURG MD
OCT 19

The Foundation for Amateur Radio will hold its annual hamfest at the Gaithersburg Fairgrounds, Gaithersburg MD on Sunday October 19, 1975. Featured is large flea market, food service, exhibits, ladies events, supervised children's program, and many prizes. Main events are all indoors. Picnic grounds and free parking available; will be held rain or shine; participation fee is $1.50; sales space $5.00; talk-in service provided; nearby motel rooms available. For information write or call Bill Miller K4MM; 10919 Woodfair Road, Fairfax Station VA 22039; telephone (703) 978-4020.

VENTURA CA
OCT 24-26

The South Western Division Convention will be held October 24-26, 1975 in Ventura, California. It will be a fun filled weekend with technical sessions, exhibits, contests, banquet, prizes, ladies' program and no host cocktail party. The convention will be held at the Ventura County Fair Grounds, with the new Holiday Inn, just two blocks away, as the convention headquarters.

The convention rates will be $18 single, $24 double, $40 suites. The Holiday Inn, P.O. Box 1628, Ventura CA 93001.

HARTFORD CT
NOV 1-2

The 1975 New England Division ARRL Convention will be held at the Hartford (CT) Sheraton and Civic Center, November 1-2. For exhibit space contact Carleton Dane W1FXK, PO Box 431, Canton CT 06019.

additions and ~~corections~~ *corrections*

"How About a Weather Satellite Monitor?", WB8DQT, August, 1975, p. 45.

The IC numbers were wrong in the caption for Fig. 1. IC9 is a 74121 and IC10 is a 741 op amp. The correct data was in the parts layout.

* * *

Being the author of *How to Compact Multiband Dipoles* (August, 1975, p. 80), I am getting piles of mail concerning a misprint of the antenna dimension data.

Under "Antenna Dimensions," Dipole A, the leg dimensions should read as follows:

About 35'6" of wire, coil, approx. 5' of wire.

I urge people to use the published formulae to determine precise wire length values.

Peter Fischer VE3GSP
1379 Forest Glade Road
Oakville, Ontario

* * *

Associate Peter Stark K2OAW notes that, in our August article entitled "Surveying the DVM Scene" (page 42), we omitted several good DVMs. Here they are. - Ed.

Manufacturer	Model	Price	Wired/Kit	Pwr Source	Digits Disp.
Micronta (Radio Shack)	22–200	$119.95	W	AC/DC	3½
Non-Linear Systems	LM–3	99.95	W	DC	3
B–K Precision	280	99.95	W	DC/AC*	3

*Optional at added cost.

J. K. Bach
Ivy Hill Road
Walden NY 12586

Megger for Peanuts

It was back in WW II days. My landlady, Gladys, had these goldfish in a big aquarium, a husband Al, a two-year-old Carol and a cat. She had noticed an attrition in the goldfish population which she attributed to the feline. She was, however, realist enough to suspect her baby daughter too. As the resident electronics expert, could I invent something that would determine guilt or repel – without harm – the culprit?

I gave this some thought. The basic scheme was to connect the light line between a ground screen (you could get galvanized iron screen in those days) and the water itself. The fish and the pipes would probably ionize the water enough.

Obvious enough, but there remained safety considerations. The kid was a card, and definitely not expendable. Limiting resistances, sure, but how big? I had heard 15 mA put forth as the least amount of current, applied directly across the heart, that would be fatal. I remembered the story I read that in. As a writer, I had utterly no faith in it. For one thing, it stated an unique value, not a range. Human beings vary at least three to one in susceptibility to inimical influences, whether electric, ballistic, chemical or a knock in the head. Taking 15 mA as a point to depart a long way from, a megohm in one side of the line seemed like a conservative place to start. But the direct other side – how could I make sure the other side stayed grounded? Simple: duck the problem, put a meg in each side.

Feeling a little silly, I tested the system, while Gladys and the goldfish watched curiously. Like all old radiomen, I'm a sissy about high voltage. Back then, about once a week, I'd get the charge from the coupling capacitors while changing coils in the big transmitters on the hill (Lawrenceville). This taught me to watch what I was doing and strengthened my vocabulary.

I didn't expect to feel much, considering the "decoupling" resistors. But I did expect to feel something, if only a tiny tingle. But still thinking of the baby, I decided to leave the setup alone for a few days before dropping resistance values.

Gladys counted her herd every day, and gave me the unchanging total each day at the supper table. Come Saturday night, with the baby in bed, Al got out the bottle and poured us all drinks. Along with a host of other things, we discussed the goldfish and decided the cat was making fools of us. We weren't drunk, but neither were we sober enough to pass up an experiment. Al caught the cat and gave her to me. Kitty didn't know what was coming, but she suspected she wasn't going to like it.

Taking her firmly by the neck, I pushed her head so that her nose would barely touch the surface of the water. At the exact instant of contact, she jerked. I tried it several times. I can't tell a microsecond any better than anyone else, but it seemed to me that here was biological-electrical rather than nerve response.

Gladys said, "Aw, the *poor* kitty–", took her from me and shoved her whole face under the water. The cat exploded out of her arms and escaped. Puzzled, I dipped my finger in again, contacting the ground screen with my other hand. If I got hit, I'd at least fall clear. Nothing. I was conscious of my audience – Al, Gladys, and the fish. I stuck my own nose in the water. Nothing. I stuck my tongue in the water and the fish backed away. Nothing. Not even the coppery taste you get from a dry cell.

We concluded that the setup was working, though it was hard to see how. Obviously, the cat had a horror of that tank. Cats smell very well, though their noses are isotropic. They often miss a bit of food within reach, while a dog scans, goes into a hunt, and locks on in practically one motion. But maybe we had an entirely new biological phenomenon here. Was a cat's nose a supersensitive indicator of an electrical charge? It certainly seemed so.

Maybe I'd go down in history as the discoverer of something called "The Kitty Effect," or an even more objectionable alternative. We all had another drink, and one of us wondered what an observer who didn't know the situation would have thought of our antics. This broke us up, and we went to bed, giggling.

From this, I did learn a little. The limiting effect of a resistance is instantaneous. The system was a big voltage divider, and the better the contact, the less voltage drop.

I forgot all this for twenty years. I wound up on a microwave test bench, and found out a lot of other things. You've heard of the Miller Effect? Ever see any evidence of it? I did. The 70 meg i-fs would occasionally

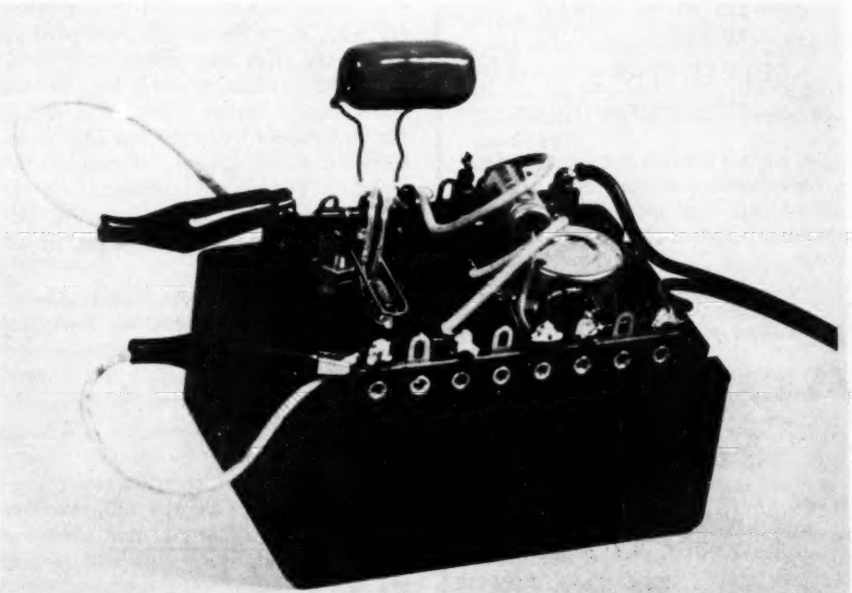

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exhibit it, and until I caught wise, drove me up the wall. The cause was defective bypass capacitors which could fail in a variety of ways. They could go open or shorted, or just lose their capacitance. These were button-mica feed-through types. We were furnished an excellent GR electronic megger. It would measure megohms up in the hundreds or thousands, I don't remember. When a bypass had as little as one meg resistance to ground, it was time to get rid of it. The two hundred fifty volts, and the heat, would break it down in a couple of weeks and you'd get the amplifier back from the field. This was not good. The best solution was to replace every cap after the amplifier was in service for a couple of years, but there simply wasn't enough stock to permit this.

Good as it was, the GR megger was too much instrument for the job. What I needed was something simple, something cheap (I was buying) and safe, because Ma Bell was watching. It should be small – the GR took up too much bench and was heavy and clumsy.

The first design worked very well in practice. The basic standard was my wristwatch, which gave me better than one part in 720 accuracy. Lighting juice went into the little plastic box to a DPDT switch. Thrown one way, it merely lighted a red pilot light (neon); the other way, connected it through a diode to a filter capacitor for a primitive power supply. A pot regulated the voltage. The slider went through a one meg limiting resistor to a binding post. The ground side of the pot went through a timing capacitor and another one meg resistor to the other binding post. Across the capacitor, an NE-2 bulb.

After the first few days, I forgot all about calibration, except for the most basic

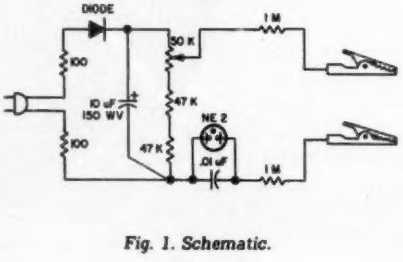

Fig. 1. Schematic.

adjustment. What I needed was a go, no-go instrument and I really had one in this gadget. All I really wanted to know was, would the cap work for a few months, or should I replace it? Twenty megs or two hundred was OK. Ten wasn't.

Of course, theory-wise, you are 'way ahead of me. It is a time-constant deal; when the voltage rises to 63% of the input voltage, you have one *time constant*, whether it is one Farad and one Ohm, or a megohm and a microfarad, right? There is something about that 63% – maybe here it suddenly becomes more horizontal than vertical, the charging curve – and anyway, an oscillator will come out to pretty close to the calculated time-constant value. And the NE-2 is both a relaxation oscillator and a timing indicator, right?

That's what *I* thought. There is a time constant that uses 63% right enough, but the time constant this gadget uses is very far from the classic one. Instead, it is time taken for the NE-2 to fall from the firing voltage of maybe 70 volts to the extinguishing voltage of about 69. You get approximately a one volt spread between these values. Of course, the timing capacitor size, the limiting resistor sizes, and the charging voltage are all factors. If you are looking for resistance, then you juggle voltage and timing capacitor size, until you come up with the proper value. Of course, it is most convenient to vary the voltage with a pot.

It surprised me that the ionize-non-ionize range was so small. I expected the voltage to drop to 15 or so. The CRO sweep tubes, 884/885/6Q5 will, but remember, they all have hot cathodes – this makes all the difference.

In actual use, I discovered that the safety switch was as useless as the well-known complementary accessories on the bull. Knowing that I couldn't possibly be hit, I was unable to remember the switch and found my fingers all over the external wiring. It was time for a new model. Perhaps a true go-no-go model *without* any adjustments? No, this was *too* radical. A pot and a knob and a hole to look through – that was the idea! And while I was about it, why not get rid of those silly binding posts? The

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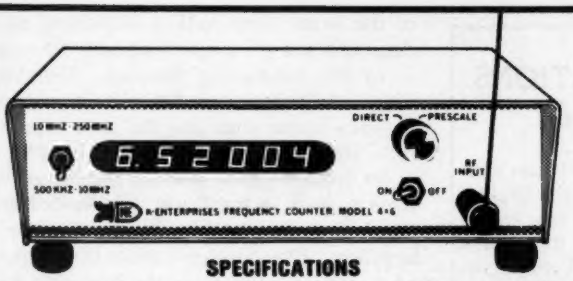
other change was to use standard commercial 8-lug strips rather than individual miniature standoffs, as in model one. Still another was to use shallow grooves in the plastic box ends for the ac input cord, and for the output clip-cords. I once knew a man who claimed that if you wanted to blow fuses, the best gadget for this was the standard alligator clip. He is right, beyond question, but in this case, with the load dead, it doesn't matter if the clip slips. And it saves a lot of bother with binding posts, which will eventually have clip leads on them anyway.

One thing I learned from commercial equipment: a ¼ Watt, 100 Ohm resistor makes an excellent fuse and protective device. Sometimes they shatter explosively, leaving only the leads. Sometimes they crack invisibly, and you find blown ones by twisting them with flats. Or, they may cook and spray the whole inside with bakelite varnish. No question what happened, the stink tells you. You can remove varnish and stink with mineral spirits (kerosene). They serve another purpose – they limit the peak charging current through the diode.

This is the model illustrated. The NE-2 (actually Japanese) was originally taped to the paper-clip, to a ground lug, which cannot be used for active connections. There are two of them. The panel has a half-inch hole for viewing the neon. The two straps short out padding resistors in the voltage-adjustment circuit, which were not needed.

Calibration is a cinch. Short the clips – with your fingers if you like – and adjust the pot for the firing rate you want. Say, 10 flashes in twenty seconds. Put your wrist-watch next to the gadget, and count flashes seen in your peripheral vision. A lot easier than it sounds, because every flash is equally bright, no matter how long you have to wait for it.

I have waited for minutes at a time to measure really high values, but for my purposes, this is time wasted. Who cares about hundreds of megohms? Now, with 10 flashes in 20 seconds you are timing out at one second per megohm, and actually accounting for the safety, or limiting resistors in the box. Naturally, you start your count with a flash, and then count 10



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more, excluding the start, or zero flash. Now if you have one, stick in a ten meg resistor. What would your timing be now? Twelve seconds between flashes? That's ten on the outside, and two inside, huh? How about one flash after nineteen seconds?

Maybe you don't want to wait 19 seconds. Then calibrate ½ second per megohm. Or any other value you want. The instrument is surprisingly linear over a reasonable range, mostly because of its limited voltage excursions as it oscillates. In theory, when the external resistance being measured exceeds the leakage resistance of the calibrating capacitor, and it's got some, the said capacitor never will charge up. It will just sit there, discharging as fast as it charges. Don't worry about it – you are not likely to experience this effect.

All right, you built yourself a megger. What good is it? The first thing to do is pick a holiday – your birthday, 4th of July, whatever. On this day you measure the insulation of your refrigerator, your air-conditioner, furnace motors – and for the love of Mike don't forget your electric drill – they are killers because you are wrapped up around them in use. Don't forget the wife's kitchen either – stove, mixmaster, iron. Write down all the values you can read. Next year, do the same thing, or sooner if you like. Does any one of them show a marked drop in the winding-to-ground value? Dump it. Get a new one. It could save a life. The box probably *will* save you money, maybe fifty times its cost. If it does, you'll be a believer from then on out.

A VOM or a bridge is a multi-purpose instrument. I dislike other examples; however, too often an additional function just complicates an instrument, makes it expensive – or more so – and in general, doesn't work out well. For instance, you could set up the megger to measure small capacitors. Please don't. Leave the "high current" high voltage in that box where it belongs.

But I did have a very odd use for the megger. I was investigating hum sources in a Kellogg 401 vacuum tube. I tried various connections and discovered that the insulation in these was very good, whether the tube was lighted or cold. The bright ends

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of the heater wires looked interesting, so I measured and got a nice reading – 50 megs – in the conducting direction. Assuming sixty volts, this gave me 1.4 microamperes as between heater ends and the plate support rods. This is a significant source of hum.

So far as I know, there are only two of these gadgets in the world. If they became popular, there might be two or three in a large city. Why wouldn't these little boxes be a perfect present for the man who has everything – else?

If he fixes TVs as a hobby and likes to measure leaks in coupling capacitors – yes. He'd appreciate one – any real technician would. But never think you could persuade a non-technical type to measure the electrical equipment around his house. To him, it would be pointless. To gift such a man with one of these is to provide a source of embarrassment to both of you. Sorry, but that's how it is. He will shelve it and hope you never mention it.

Of course, it's my baby, but I wouldn't be without it.

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Say, OM, Are You a Computer?

As IC construction projects become more and more complicated, it becomes clear that the logical endpoint is a gadget that handles the whole QSO – sends out a CQ, answers the call, decides on a signal report, describes the rig, asks for (and promises) a QSL, and taps out a sincere "73" at the end. A recent *QST* project, the Contester, was in fact a fairly sophisticated unit for handling all of the bookkeeping in contest operation. In that article and others, the prediction of the computer-controlled ham station is made.

I've just seen a piece of that station in operation. Robert Snider, a 14 year old high school student in Cold Spring Harbor, New York, has configured a PDP-8 minicomputer to send and receive the International Morse Code. The interesting part of this is that it was not a construction project; Bob never heated up a soldering iron or bored a hole in a panel. Instead, as an exercise in *programming* for a math project, Bob essentially "taught" the code to the computer and devised an ingenious way for it to send and receive.

As computers go, the PDP-8 is a pea-brain. In reality, it owes its fame and success to the fact that it does less and does it more slowly than the computers that preceded it on the market. By being a not-too-bright midget, the PDP-8 started what some have termed "the minicomputer revolution".

Almost from the first machine that deserved to be called a computer – a room full of vacuum tubes at the University of Pennsylvania – the evolution of computers has been that today's machine is faster, does more, and has a larger memory than yesterday's. This progression of smarter and smarter machines – with higher and higher price tags – was in full flower when the designers of the PDP-8 realized that there were many jobs that could be handled by a computer of modest accomplishments. These jobs at that time were being done by laboriously designed collections of special circuitry because a simple (therefore cheap) computer just didn't exist. So the bright guys at Digital Equipment Company took a fair-sized step backward and introduced the PDP-8 to what turned out to be a waiting world. The PDP-8 is slow, it has a limited memory, and as a mathematician it is pretty poor – it can only add. If you want subtraction you have to add a negative number. Multiplication and division are implemented by software subroutines. However, the PDP-8 was, for its time, small in size and dirt cheap. It became possible to think of the computer as a component, the controller of a larger system such as an automated drafting table, or the overseer of a complicated process like the management of a portion of a pipeline system.

Since 1958 when the PDP-8 was introduced, computers have been built into hundreds of systems, and the PDP-8's successors and imitators have proliferated until there are now scores of minicomputers on the market. The PDP-8 (shown with Bob Snider in the photograph), has been slimmed down considerably. Originally it was an ungainly 3 foot high unit with its PC boards showing. One manufacturer is even offering the "Naked Mini" – essentially a PDP-8 minus power supply, switches and cabinet – on a single giant PC board. Minicomputers can now be had, with performance equal to the PDP-8, for about $1500. Considering what the plutocrats in ham radio spend on their rigs, this is the right ballpark for inclusion in that "super station".

The job of programming a computer to handle the code was basically a simple one, according to Bob Snider. His ingenuity lies in the way he developed for the machine to send the code, without any electrical connections. For those of you who have never met a minicomputer, it's basically a RTTY op. You type to it; it types back to you. Since Bob's goal was audible code, this wasn't satisfactory. And since the computer is owned by Cold Spring Harbor High School, getting inside to make a wire connection to a keyer or code oscillator was forbidden. But Bob discovered that if he put the computer into a programming loop (in which it endlessly repeats the same operation), the machine generated enough stray rf to be heard on a nearby broadcast receiver. *Voila,* the wireless transducer!

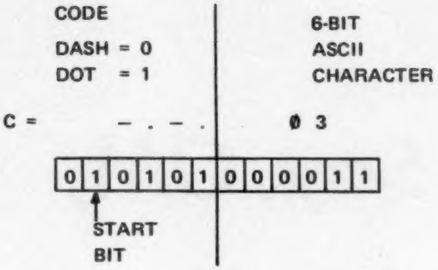

Fig. 1.

The program thus switches in and out of a loop for appropriate lengths of time to generate dots and dashes corresponding to the text that has been typed into it. Speed is no problem; it asks you what you'd like. It's equally comfortable with one or 99 wpm. In fact, it could go faster but for one thing which Bob considers a minor goof – he made the slot where you insert the desired speed only two digits long.

How is it done? Bob explains that the PDP-8 has a twelve bit word – that is, the basic building block of any program is a series of twelve binary digits. This also corresponds to one memory cell. The keyboard outputs 6-bit ASCII characters and the task of the program is to match these up with dots and dashes. Now, matching is something even a simple computer does well. So the six-bit ASCII character is inserted in the second half of the word, and the correct dots and dashes in the first half. How it works for the letter C is shown in Fig. 1.

The entire alphabet, plus the numbers, is stored in a table of these words in memory. When you hit a letter on the keyboard, the keyboard output (ASCII) is compared to the right half of the words in the table. When a match is obtained, the left half (code) is placed in a register and shifted left to the start bit, always a 1. This bit is ignored, but the next bit causes the loop to run to produce tone – for three units of time if 0 (dash) or one unit of time if 1 (dot). The units of time have been computed by another section of the program to be appropriate for the speed you asked for. Succeeding bits produce dots or dashes until the end of the six-bit half word (or "byte"). All characters are right justified, so the byte end serves as a stop signal.

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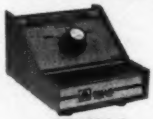

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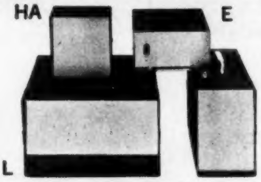

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This is the "SEND" mode of the program in which the computer sends to you. The "RECEIVE" mode has the human operator sending and the computer translating to typed characters on the teletype. No key could be connected by wires, remember, but Bob recollected that the "BREAK" key (used generally to interrupt a program in process) is the one key on the keyboard that gives a simple contact closure; no ASCII code is generated. So this key is used as a telegraph key.

The break key is not ideal for this purpose. I couldn't send the computer anything it liked. It kept typing out ERROR in response to my sending. It turns out to be rather finicky as to the rhythm and spacing it will accept. It reads Bob Snider like a champ, though.

I should add at this point that the program wasn't designed to duplicate a code typer or code reader. Instead, it was conceived as a teaching machine to teach the code to complete neophytes. For this reason, it has other modes than "SEND" and "RECEIVE". In the "LOAD" mode, the user types a complete message into memory, which on the SEND command the machine transmits to the radio. Proper character and word spacing for the selected speed are automatic.

In the "LOOK-UP" mode, the user types any letter or figure, followed by an equal sign, and the computer prints the code character using periods and hyphens for dots and dashes. There's even a "TUNE" mode, in which the computer "holds its key down" so that you can adjust the radio's tuning and volume for best reception.

This program won the top award for Bob Snider in the Long Island Mathematics Fair. He submitted a paper describing the program, and then, on March 22, 1974, gave the paper orally and demonstrated the technique for a panel of judges. In competition with the work of the brightest math students from schools all over Long Island, Bob's project won. In talking to him and seeing the demonstration, I got the distinct feeling that he considers this program kind of old hat by now. It turns out Bob Snider developed this when he was in the 8th grade. His advisor also told me that Bob has won the Long Island Mathematics Fair three years in a row, a feat about as common as a team winning the World Series three years in a row.

Bob's into other things now – reprogramming the computer so it can be time-shared among several users, and possibly handle the Cold Spring Harbor High's attendance and scheduling records as a side job.

He admitted he's too busy with these things (and a new sailboat) to think about getting a ham ticket. So if you do contact a computer one of these days, it probably won't be Bob Snider behind the scenes.

It also may not be in the CW portion of the band. While I was at the school, another teen-aged programmer, Craig Hansen, demonstrated his latest program for me. It seems Craig's program makes the PDP-8 literally *talk* – in a pleasant baritone voice that's completely synthesized from binary numbers. Not perfectly though. It speaks a little too slowly for contest work . . .

. . . W2IAT

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Digital Clock Time Bases

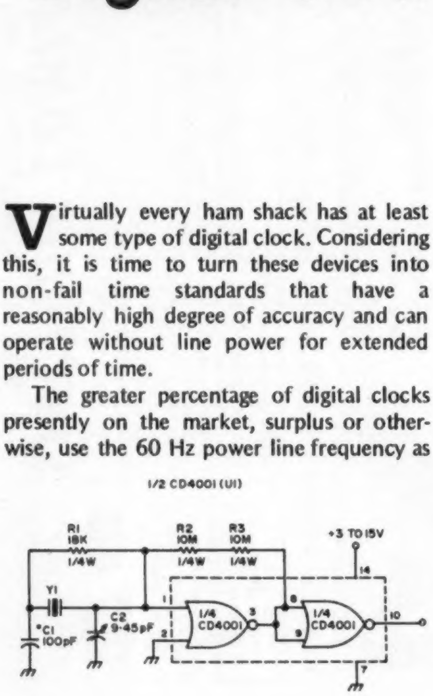
Virtually every ham shack has at least some type of digital clock. Considering this, it is time to turn these devices into non-fail time standards that have a reasonably high degree of accuracy and can operate without line power for extended periods of time.

The greater percentage of digital clocks presently on the market, surplus or otherwise, use the 60 Hz power line frequency as their time reference. Also, the majority of these clocks employ large scale integrated circuits. The line frequency source is reasonably accurate; however, if you desire increased accuracy and reliability, crystal control is the answer, especially during power failures.

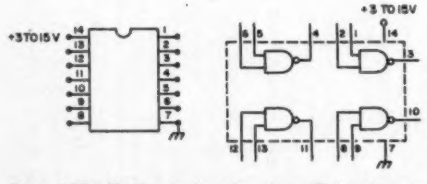
The greatest power consumption in a digital clock is that consumed by the LED readouts. The clock "chip" does not usually require a great deal of current. Therefore, if you are operating on crystal control, only the crystal, divider chain and clock chip must be provided with battery power during a line power failure. As we have mentioned before, the clock integrated circuit requires only a few milliamperes. The LED readouts can be wired so as to automatically extinguish during a power failure.

The next problem of concern is that of the crystal oscillator and divider chain. For a reasonable degree of timekeeping accuracy, a moderately high frequency crystal must be employed as the standard. When the crystal frequency is divided down to 50 or 60 Hz, the ratio must be great enough so that minor crystal drift will not appreciably affect the 50 or 60 Hz output. We mention 50 or 60 Hz because this is the necessary "clock" frequency needed for proper operation of common clock chips. With minor circuit modification, the majority of chips will function equally well with 50 or 60 Hz.

1/2 CD4001 (U1)

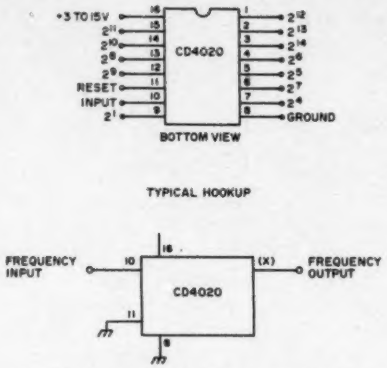


CD4001 PIN CONNECTIONS



C1 = 100 pF silver mica capacitor. This value may have to be determined experimentally depending on the crystal frequency you are using. 100 pF is a good value to start with.

Fig. 1. Basic CD 4001 oscillator.


+3 TO 15V
2^11
2^10
2^8
2^9
RESET
INPUT
2^1
CD4020
2^12
2^13
2^14
2^6
2^5
2^7
2^4
GROUND
BOTTOM VIEW
TYPICAL HOOKUP
FREQUENCY INPUT
FREQUENCY OUTPUT
CD4020
(X)

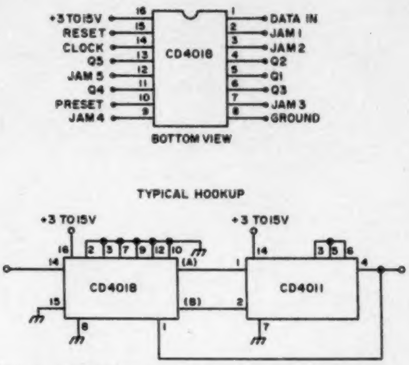
Note: Pin (X) should be the following for desired divisions.

Division Desired	Pin (X) number
2^{14} (16,384)	3
2^{13} (8192)	2
2^{12} (4096)	1
2^{11} (2048)	15
2^{10} (1024)	14
2^{9} (512)	12
2^{8} (256)	13
2^{7} (128)	6
2^{6} (64)	4
2^{5} (32)	5
2^{4} (16)	7
2	9

Fig. 2. CD 4020 pin connections and divide by 2 configurations.

When you think of a crystal divider chain, it is common to imagine a large number of ICs consuming a considerable amount of current. With garden variety TTL integrated circuits the above was true. COS/MOS ICs present a completely different story. This new breed of low power integrated circuit can make a very low power divider chain entirely possible. The crystal oscillator, divider chain and clock chip all working together will represent only a small current drain. The COS/MOS devices also will work well over a much wider voltage range (3 to 15 V) in comparison to TTL (4.75 to 5.5 V). The COS/MOS devices used in divider chains are also quite inexpensive.

The run of the mill cheapskate such as myself doesn't mind spending a small fortune on ICs; however, spending $2.50 for a proper crystal is another story. Get out that batch of surplus crystals that you have been hoarding, as it may well surprise you what can be divided down to 50 or 60 Hz.


+3 TO 15V
RESET
CLOCK
Q5
JAM 5
Q4
PRESET
JAM 4
CD4018
DATA IN
JAM 1
JAM 2
Q2
Q1
Q3
JAM 3
GROUND
BOTTOM VIEW
TYPICAL HOOKUP
+3 TO 15V
+3 TO 15V
CD4018
CD4011
(A)
(B)

Note: CD 4018 pins (A) and (B) should be the following for odd divisions.

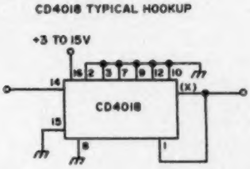
Division Desired	Pin
"9"	A=11, B=13
"7"	A=6, B=11
"5"	A=4, B=6
"3"	A=4, B=5

Fig. 3. CD 4018 pin connections and odd division configurations.

Using COS/MOS integrated circuits, an average divider chain including oscillator can be constructed for about $10.00 – probably less.

The upper frequency limit for COS/MOS ICs is approximately 3 MHz and it is not wise to exceed these limits for reliable operation. Crystals below 30 kHz are not really common and the ratio is not great enough for exceptional accuracy.

In all cases, the oscillator is the CD 4001AE quad 2 input gate. This circuit (Fig. 1) is quite good and most stubborn crystals


CD4018 TYPICAL HOOKUP
+3 TO 15V
CD4018
(X)

Note: Pin (X) should be the following for desired divisions.

Division Desired	Pin
"10"	13
"8"	11
"6"	6
"4"	4
"2"	5

Fig. 4. CD 4018 – even division configurations.

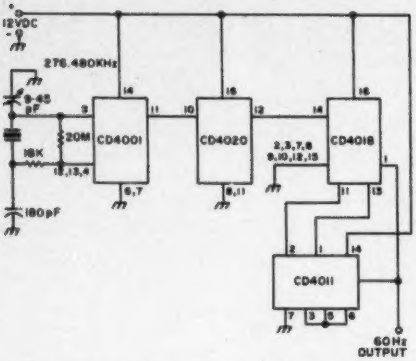


Fig. 5. 276.480 kHz to 60 Hz divider chain.

will work well. C2, the 9-45 pF trimmer capacitor, should be either ceramic or a good grade air dielectric variable capacitor. This is used in conjunction with C1 to adjust the crystal exactly on frequency. C1 should be a good quality silver mica capacitor. Depending on the crystal frequency, the value of this capacitor (C1) may have to be altered. 100 pF is a good value at which to start for crystals in the 100-300 kHz range. A frequency counter is perhaps the best way to align the crystal frequency. With odd crystals, it may be difficult finding a harmonic that will zero beat with WWV.

Before we proceed further, the COS/MOS devices have built-in protection against electrostatic effects; however, certain precautions must be taken. Handle the IC as little as possible and leave it in the protective "black plastic" until you are ready to insert it in its socket. Ground yourself, the PC board and your soldering iron and do not touch the IC pins when inserting it in the socket. It is wise to use sockets but if you must, solder the ICs in place using as little heat as possible.

The CD 4020AE is a 14 stage ripple carry binary counter/divider and the CD 4018AE is a presettable divide by "N" counter. By using proper combinations of these two ICs a wide variety of crystals may be divided down to 50 or 60 Hz.

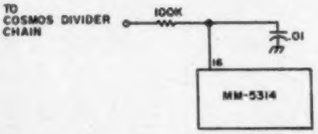


Fig. 6. Divider chain to National MM-5314. Note: Should the 5314 not count, decrease the value of the 100k resistor.

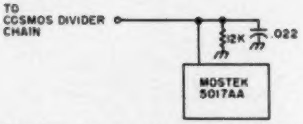


Fig. 7. Divider chain to Mostek 5017AA (Heathkit clocks).

The CD 4020AE has the ability to divide by two fourteen times, which results in a total division capability of 16,384. Other pins on the IC sample division flip flops at 2^1, 2^4, 2^5, 2^6, 2^7, 2^8, 2^9, 2^{10}, 2^{11}, 2^{12}, 2^{13} and finally 2^{14}. The assorted division capabilities of the CD 4020AE are then 2, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192 and 16,384 respectively. Output pins for 2^2(4) and 2^3(8) are not provided on the IC. Fig. 2 illustrates pin connections for the CD 4020AE. Fig. 2 also illustrates how you would wire this IC for divide by configurations of 2.

The frequency input would go to the CD 4001 oscillator pin #10. An illustration such as this makes it easier when you are seeking a particular needed division.

The CD 4018AE presettable divide by "N" counter was primarily intended for synthesizers and other exotic devices. It has the ability to divide by 10, 8, 6, 4 and 2 with no external components. If you desire to divide by 3, 5, 7 or 9, a CD 4011 positive NAND gate must be employed, in addition to the CD 4018. Fig. 3 illustrates pin connections for the CD 4018AE. Fig. 3 also illustrates pin connections for the CD 4018AE. Fig. 3 also illustrates how to wire the CD 4018 and CD 4011 for a divide by 9, 7, 5 and 3 respectively. Fig. 4 illustrates wiring of the CD 4018 for division of 10, 8, 6, 4 and 2.

With a good variety of surplus or oddball

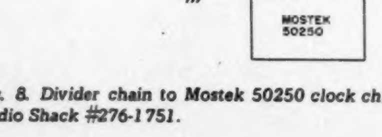


Fig. 8. Divider chain to Mostek 50250 clock chip Radio Shack #276-1751.

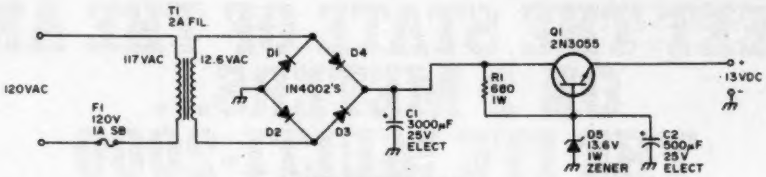


Fig. 9. Power supply.

crystals, there is a good chance you can find one that will divide down to 50 or 60 Hz. The easiest way that we have found to do this is with a calculator. Take the crystal frequency and divide it by 10s, 9s, 8s, etc., until you arrive at a small enough number that you recognize as a multiple of 50 or 60. If this does not work, try dividing by 7, 8, 7, 8, etc., or other combinations. Of course, you can try dividing the crystal frequency directly by 50 or 60. All of this may sound tedious but it does work.

As an example, a crystal frequency of 276,480 Hz would require division by 2 (9 times) and then by 9, giving a total division of 4608 to obtain 60 Hz out. Fig. 5 illustrates the CD 4011 oscillator stage, a CD 4020 wired to divide 2 (9 times), and a CD 4018 and CD 4011 wired to divide by 9 resulting in an output of 60 Hz.

By using the basic building block IC diagrams, you should have no problem creating your own crystal divider stage for a digital clock.

Figs. 6, 7 and 8 show how the divider chain 50 or 60 Hz would be fed into three common clock integrated circuits. Fig. 6 is the National MM-5314 which has been used in many recent published clock projects. Fig. 7 is the Mostek 5017AA which is the chip used in the Heathkit digital alarm clocks. Fig. 8 is the Radio Shack #276-1751 (Mostek 50250) clock chip.

Fig. 9 is a power supply that can be employed for the "perpetual" clock system. With our particular system, we were using the 50250 clock chip which operates nicely from 9 to 15 volts. The 13 volt supply for the ICs ran both the 60 Hz divider chain and the 50250 chip. The reason for using 13 volts is to facilitate changing over to a 12.6 volt battery during a power failure. Fig. 10 is the "changeover switch" from power line to battery. When +13 volts is present from the ac supply D1 conducts and D2 is reverse biased so the battery source draws no current. When the 13 volt source drops below 12.6 volts, D2 conducts and the battery automatically takes over. With this system there is no interruption in timekeeping whatsoever.

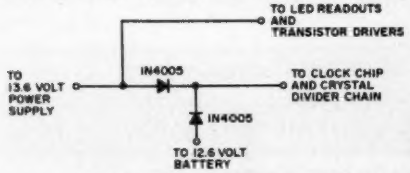


Fig. 10. Power changeover diodes.

I hope that the previous will give you many ideas which you can apply to your present digital clock to make it "perpetual".

. . . W2AOO

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Fast Dive on Five

or, Assault by Battery

Something was definitely cockeyed with the little airplane. It was a Waco biplane, powered by a World War I OX5 Engine. Looking out from my open cockpit, houses and streets were directly off the wing tip, sort of topsy-turvy as we flew in a tight circle, tipped way over and going down. Centrifugal force pressed me into my seat. It was almost like being in a huge whirlpool, with very hard ground coming up at us fast, now only a thousand feet or so away.

Whipping around, I saw the pilot's contorted face. Charlie Saxe was not one to panic easily. But he was yelling at the top of his lungs and pointing a finger at me. I couldn't hear what he was saying due to the rush of air and roar of engine and propeller. Then he pointed his finger down in a jabbing motion toward the plane's flooring.

I looked down. In the blinding sunlight and because the radio gear in front of me obscured my feet, I could detect nothing wrong. However, something was dreadfully amiss with his controls. It looked as though we'd had it.

How did we get in such a crazy situation? I'm sure Charlie Saxe was asking himself that and wondering why in hell he had succumbed to my blandishments about ham radio and the marvelous new 5 meter band. And aircraft mobile operation!

For a moment, let's go back a bit. Very high frequency radio experiments all started for me in the early 1930s. The interest was stirred up by my good friend Ross Hull, brilliant radio engineer, inventor and master of many arts. As one of the top men at ARRL headquarters in West Hartford, he had developed and published in QST a number of fascinating AM voice circuit configurations for small 5 meter (56-60 MHz) gear, particularly suitable for mobile operation.* Although the units were reasonably compact, the main drawback was their dependency on vacuum tubes with high filament current characteristics. This required a heavy-duty storage battery. Plate power came from banks of 22 volt "B" batteries, the transmitter input being only a couple of Watts.

"Just think," Ross said, "for millions upon millions of years there's been nothing but utter silence in this section of the spectrum. Not even static. Get out there and make some noise — and some records."

It was pretty much line-of-sight stuff, comparable in a way to our current 2 meter activity. Satellites and repeater gimmicks? Hell, no. Prearranged schedules were

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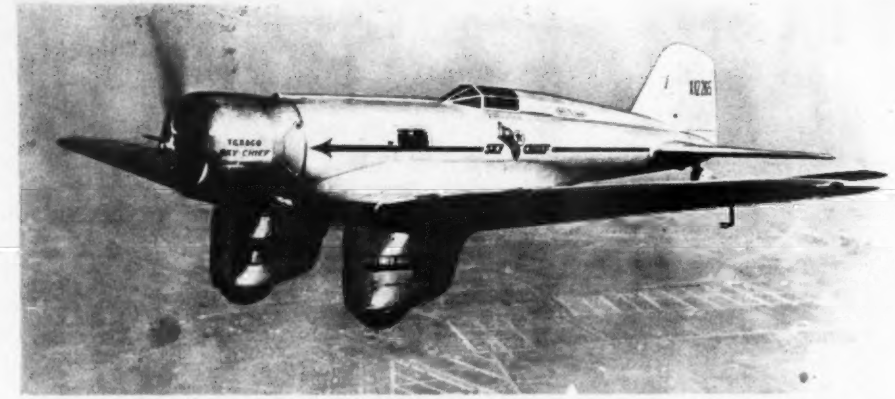
*Note: Amateur operation in the 5 meter band was later withdrawn by the FCC.



Distance-Altitude Charger: In this fastest plane of transport type in the world, Lieut. Commander Frank M. Hawks traveled the air lanes high above the earth seeking to learn new secrets for aviation. The craft, christened the Texaco Sky-Chief, attained its greatest efficiency in the high altitudes, cruising at more than 200 miles an hour for 2,500 miles, at any height up to 30,000 feet. With this plane Hawks was demonstrating in terms of speed and load the transport possibilities first agitated with the midget mystery ship which he formerly flew. Among the many newest improvements of aeronautical science with which the plane was equipped was an automatic robot pilot to keep the craft indefinitely on any set course without the help of the man flying it. A split trailing edge of the wing provided a pair of flaps or "air brakes" which when lowered permitted landings at less than 50 miles an hour or in an unprecedented ratio of 5 to 1 between top and landing speeds. Modified use of the flaps also gave the plane greater lift, reducing the takeoff run approximately 30 percent. The ship was an all-metal full cantilever Northrop Gamma powered with a Wright Whirlwind engine of 14 cylinders, the first such power plant produced commercially, others having gone to the U. S. Navy.

practically a must. Otherwise, one could be getting out like a ton of bricks – with nobody around to hear the signal.

Following Ross Hull's suggestion, I had built up two transmitters and two receivers. The best antenna proved to be a half-wave vertical steel curtain rod, brass plated and fed with an open wire line. Soon, another local ham, Ralph Hunter W2AKH and I had used the units for many mobile operations from a base station in my family's house at Catskill, N.Y., to a car or speedboat in motion up to 10 miles or so away on the Hudson River. In August, 1932, a world record of about 75 miles was made between my station, W2AMD mobile at the Catskill Mountain House at 2,200 feet, to W1WR on Mt. Greylock, Mass., a line-of-sight path.

Shortly after came our fast talk with Charlie Saxe, suggesting he let us try operating from his plane. We figured this would really rope in some DX. His welcome cooperation soon led to my taping the half-wave vertical rod to one of the wing struts on his little aircraft. A horizontal structural bar at about chin level across the front of the passenger cockpit offered an ideal place to strap the small transmitter and receiver boxes. To let Charlie in on the fun, I'd paralleled a pair of headphones, so at least he could hear our ground stations. But he had no microphone.

Well, to get back, we were soon airborne and in dandy contact, not only with my ground station but with Ross Hull in West Hartford, some 70 miles away.

Then I asked Ralph at W2AMD to suggest to Charlie that we fly back over Catskill and circle over the town, testing signal strength at close haul. And that's when the trouble started. The radio contact is what saved our lives. Fortunately the mike cord was long enough to hand the mike back to Charlie, who instantly got the idea, as I switched to

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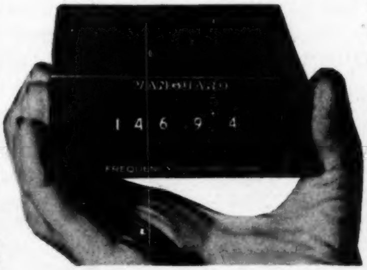

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transmit. I could see that he was talking into the thing but of course couldn't hear what he was saying. When he'd obviously finished, I switched to receive and immediately heard Ralph's voice, "Charlie says for Chrisakes get your goddamned feet off the controls before the goddamned plane crashes!"

I knew that my feet were nowhere near the dual controls. Hastily removing my safety belt and twisting down, I discovered the trouble. The filament storage battery, not tied down as it should have been, had slid across the floor boards and jammed the dual foot control into our steep downward turn. With enormous effort by hands and feet, I managed to move the battery against centrifugal force – and uphill. Aided by Charlie's foot pressure on the controls, I got it far enough out of the way so that we resumed level flight.

Catskillians later swore that our landing wheels swept so low over the town that leaves fluttered down from some of the higher elm trees.

You'd think that my joy ride on that afternoon would have chilled any further experiments in aircraft. Not so. The following year I was zooming along at 10,000 feet over eastern Connecticut in Lieut. Commander Frank M. Hawks' Sky Chief low wing monoplane. He had me comfortably stowed in the luggage compartment between the gas tank and his pilot's seat. His feet and a maze of wires and cables were close to my back. Again we were running experiments with Ross Hull, who was operating from his house on Selden Hill in West Hartford. Our gear was approximately the same as my earlier stuff, but this time our attention was on improved antennas. A big half-wave rod was not practical on Frank's all metal, streamlined plane. We had settled on a quarter-wave job, which was bolted to a plastic plate just over my compartment. This worked just fine. We made additional contacts with stations in Boston, Providence and New York.

However, earlier in the day things had not gone so well. Some clown at Frank's Springfield airport had secured the ¼-wave vertical in a weird lash-up that had a streamlined plastic housing around it. But, oh boy, you

Lt. Comdrs. Frank M. Hawks and John M. Murray at Springfield, Mass., where Hawks' new GeeBee racer was being built in 1933. This plane and a somewhat similar one for Jimmy Doolittle, later of Tokyo raid fame, was almost entirely constructed of laminated wood – and seemed little more than a platform with stubby wings for an enormous engine.

just can't go hanging things on airplanes willy-nilly. On our first takeoff from Hartford's Brainard Field we had reached altitude and were headed for coastal regions near Providence, R.I. Suddenly, all fury seemed to break loose in a tremendous vibrating noise directly over my head. Through the wires and cables, I looked up at Frank. He didn't seem to be concerned, maintaining the marvelous calm which characterized the guy. He waved a sort of "don't worry about it" hand at me. Nevertheless, we immediately went into a sharp descending curve and headed back toward Hartford. For an instant the noise stopped – then increased greatly and the whole airplane began to shake and vibrate. Next came an explosion like a shotgun blast. The vibration ceased and so did Ross's radio signal. Frank smiled and scribbled a note on the pad strapped to his knee. This he held out to me, "Resonant point – wind vibration of antenna housing. Broke loose. All OK. Cheer up!"

Back at Brainard Field we soon had another ¼-wave vertical job secured, minus the screwy streamlined housing. Two small guy wires with egg insulators were fastened fore and aft to the airframe skin.

Since Frank Hawks had become somewhat of a national hero in the wake of ocean fliers like Lindbergh and Amelia Earhart, quite a crowd of well wishers, if not hero worshipers, had begun to hang around the airport while we were on the ground. Naturally, a few police began to show up to keep things under control. One officer of immense frame, with walrus mustachios, seemed to always be on hand, looking for trouble and with a jaundiced eye toward our whole operation. Judging by his braid, he was real big stuff around town. "You fellers are going to smash yourselves yet in that flying machine," he told us. "If the Good Lord had wanted man to fly, he'd have screwed wings on his back."

Frank surveyed the old boy politely. "I'll give you a nice ride later, Chief."

"No, thank you, son."

Once more we were off with the repaired antenna working beautifully. I stared at the huge green painted gasoline tank that formed the front wall of my compartment. Scrawled on it in pencil was a cute little message from another famous Atlantic flier: TANKS FOR THE RIDE, FRANK. AMY MOLLISON.

Ross Hull's familiar accented Australian English came booming over our headphones, "Frank, old chap, would you please take her up to about 12,000 and circle Hartford within about 10 miles? I've got the new rotary directional antenna ready for a try."

"Will do," said Frank. We began to climb sharply.

To the west the sun was lowering toward the Litchfield hills. Below, a snake-like ribbon of silver indicated the Connecticut River as it wound off into the haze toward Long Island Sound. Up, up we went.

Again Ross's voice. "Oh, yes. You characters are expected out here for cocktails when you return to earth. KB (Warner) says he'll meet you at the airport. How's your altitude?"

On this flight we had a monitor, so I could hear both sides of the conversation.

"Just about 12,000," said Frank. "We're now over the center of Avon, heading east."

"OK," said Ross. "Please peak up your signal for maximum output. I'm going to take readings as I change the vertical angle as well as rotate the antenna."

At some 250 miles an hour plus we weren't going to be over the tiny town of Avon very long.

Frank turned half around in his seat to make the adjustments Ross had requested. The transmitter and receiver were on a shelf behind his head. In turning, his knee pushed lightly and then with more pressure against "the stick". Of course, the plane nosed down, our speed certainly increased and my blood pressure began to mount. By now we were practically in a power dive right over the center of Hartford. And Frank continued fussing with the radio, an activity in which I had lost all interest.

A quick glance out the window showed we were headed almost exactly for the Travelers Insurance Company's huge tower – and streets which probably were crowded with evening commuter traffic.

Was I, who had never piloted a plane, to tell the great Frank Hawks how to handle his ship? Would he never quit those adjustments to the radio? Along about then the self-survival urge took over! Acting almost mechanically, I reached back and grabbed his ankle. That ought to get his attention. It did. He turned a pleasant smile on me and pulled the stick back easily, bringing us back to level flight. I could feel warmth returning to my cheeks. In fact, my face was very red.

It was certain that our power dive had raised a fearsome noise over the city. There was no delay in our being reminded of this when we landed and taxied up to the control tower area. Our mustachioed police chief friend came purposefully striding toward the plane, looking like a thunderstorm. "Commander Hawks, I regret to inform you that there is a city ordinance against the kind of games you have been playing up there. You may consider yourself under . . ."

His words were cut short by the screaming siren of a big black limousine which drove up near our plane. Out popped a little man, the mayor of Hartford, all smiles. He was arriving for an official welcome. "So sorry I was unable to get down here sooner, Commander." The law, stroking his whiskers, quietly faded into the background and was not heard from further.

Later, at cocktails with Ross and KB, Frank turned on his weatherbeaten smile. "If I live to be 100, I'll never forget the look on your face when you grabbed my ankle. I was aware of our dive, but there wasn't any real danger – and I like a little speed, as you know. If I'd been in your shoes, though, I think I'd have done the same thing."

Despite those reassurances, I've always wondered just how aware he was of that dive. Only a few years later, while demonstrating an "absolutely foolproof" plane over an upstate New York golf course, he flew himself into some high tension wires. And that was the end. The very end. As Jimmy Doolittle once remarked, "There are plenty of stupid young pilots around. But I don't know of any stupid old pilots." Perhaps, in this case, more tolerant judgment would suggest that Frank was merely a trifle careless.

. . . W1BNN

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HIJACKED: IC22 s/n 13-12-122 2m FM in Dallas, Texas on August 11, 1975. Report to Perry W. Barker WA5IKU-0VS, 2240 Prichard Ln., Dallas, Texas 75227.

ROBBED: Standard 826M s/n 203046. Notify Jack C. Hemby, 3408 O'Hara Rd., SW., Huntsville, Ala. 35801, or the Huntsville, Ala. Police Department.

ABDUCTED: Motorola PT-300 s/n J-28196, Nicad pack and charger crystals 146.34-94 and 146.31-91. Contact WA2AJQ or Syracuse, New York Police Department.

LIFTED: FMDX s/n 090 in Passaic, New Jersey on August 6, 1975. Contact Mike Stefanik K2QHI, 504 Grace St., Garfield NJ 07026.

HAM HELP

According to long-standing policy, *73 Magazine* makes a continual effort to match those in need of technical help or instruction with those who feel they can offer it. If you find yourself in one of these two categories, please do yourself and amateur radio a favor by contacting Ham Help, *73*, Peterborough NH 03458.

Alan Binkelman WN9RNS
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de W2NSD/1

EDITORIAL BY WAYNE GREEN

from page 3

regular computers. The Altair system can do just about anything one of the $100,000 computer systems can do!

There are quite a few games available in Basic and, after a few demonstrations of simple calculations done with the Basic program, they fed in a Hammurabi game – a relatively simple game whereby you have to figure out how much wheat to plant, how much land to sell or buy, etc., to run a small mythical kingdom. Unless you are pretty sharp you end up wiping out the country in short order as I did. Probably the worst result of this is an almost instant addiction to computer game playing.

People's Computer Company, Box 310, Menlo Park CA 94025, has a whole big book of games you can play on your computer – book is $7 and a bargain. The game programs are in Basic.

Having heard horror stories about some computer nuts getting so addicted to the Star Trek game that they have allegedly almost starved to death rather than leave an unfinished game, I found that MITS did indeed have a program for said game. It is formidable, requiring 24k of memory, and that isn't cheap even yet. Oh well, it's only a hobby, right?

There are some exciting developments on the way in bulk memory storage devices – Sphere is talking about having 1,500 Megabytes available at a very reasonable (hobby) price! Almost every day I hear about another firm entering the field producing memory boards, interface boards, computer boards, video display boards, etc. It's exciting, and there will be a lot of fallout for the radio amateur.

Most of this stuff is directly usable for RTTY and much will complement slow scan. A whole new era is upon us. I'm reading everything I can get my hands on so I'll know what's happening and be in on it – how about you?

TUCKER AND JUGE

While on my swing through the Southwest I paid a short visit to my old stamping grounds in Dallas/Ft. Worth. Things have sure changed since I lived there a few years back. I used to live way out in the outskirts of Dallas – this time the outskirts had moved several miles past my old digs and it was solid houses instead of fields.

No visit to Dallas would be complete without a stop at Tucker Electronics. Jim has a fantastic thing going out there – and a two meter FM signal that lifted just about every repeater for three states around. I managed to get there while Jim was away on vacation, unfortunately. Well, better luck next time.

Ed Juge was hard at work when I visited him and we rapped for several hours. He's got a very good thing going in Ft. Worth – and you'll have a hard time finding a nicer chap to talk with.

I was hoping to find more fellows to talk with on the repeaters, but despite repeated attempts at raising a contact, I managed very few. There are a fantastic number of repeaters there, but I seldom heard more than the 34/94 in use. No, it wasn't that my call turned them off, I don't think anyone ever gets my call right the first time around, and darned few the second or third. I'm used to it now. Oh, I spell it out, but the call is forgotten before I'm through giving it. No, it wasn't anything personal against W2NSD/5, just a current FM way of life that I was bucking.

BOX SCORE

The ads in a ham magazine are of particular interest to readers – we all want to know what is new, where we can save some money and (probably most important of all) where we can get what we want. Ads are the major means for selling ham products, so they are of interest to manufacturers, too. And since ads help pay for more pages of articles in a magazine, this is another benefit to the readers.

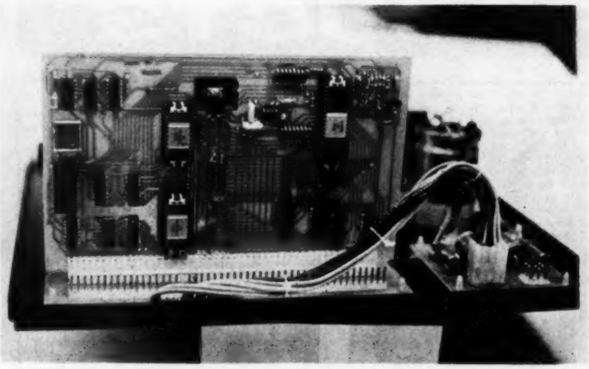
The circle works out like this – the more ads, the more articles; the more articles and ads, the more readers; the more readers, the more ads (because there are more products sold). It feeds upon itself and everyone benefits.

During the last quarter 73 has run 252 pages of ads, QST 180, HR 126 and CQ 76, near as I can count. Thus, despite the strictest advertising policy in the field, 73 has run substantially more ads.

About that strict ad policy – if you ever have any legitimate gripe with a manufacturer or dealer, please make sure to send a copy of your letter to me so I will know what is going on. This particularly holds for dealers who are having troubles with manufacturers or importers. Every now and then something comes up and only after I have put something in print do I begin to get the full horror story of what has been happening. Please clue me in when something is fishy.

For instance, there was one manufacturer who was shipping sets to dealers and they were bouncing back like rubber balls. Would you believe eleven sets to one dealer and not one single one worked right? This advertiser is no longer in 73 . . . but you'll find his ads in at least two of the other magazines . . . good luck. Another pulled so many funny deals it would take a book to reprint the complaints . . . he, too, is advertising in a couple of the other ham magazines . . . good luck. How about an outfit that will under no circumstances make a refund? . . . good luck again . . . with ads in two other ham mags.

Dan Meyer, the chap who brings us the Southwest Technical Products video display and keyboard kits. Dan had a big surprise for me . . .



The SWTPC surprise — a working computer unit using the Motorola M6800 chip. This was hooked up with the keyboard and video display for input/output.

And how about the manufacturer who has been shipping sets COD, knowing they are defective? The sets come back for repairs and are promptly resold to other COD buyers . . . good luck. The ads for this bomb are not in 73. You like antennas? You may be lucky enough to spend a bundle and get something that works almost as well as a piece of window screen . . . but not out of 73 . . . and good luck to you. Or perhaps you'd like to buy some antenna kits which turn out to be inferior grade aluminum tubing and a set of mimeo instructions telling you where to drill holes and how long to cut the elements? . . . they're cheap, but you won't find 'em in 73 . . . I'd tell you where to look, but you'd accuse me of being rotten to someone. Good luck.

Disclaimer . . . there are a few manufacturers who won't advertise in 73 . . . they don't like the editorials and feel that they can force the editorial policy to change by refusing to advertise . . . that won't work: Only letters from readers will do this, since 73 is in the business of providing a magazine to be enjoyed by readers, not to express manufacturers' beliefs . . . unless they want to buy the ad space, and then they are welcome to say anything they like as long as it doesn't open us to another damned law suit. At any rate, just because someone is not advertising in 73 it doesn't mean that we won't take their ads . . . I wish it was that way . . . but not enough to turn the editorial column into a lily-livered committee effort. The fact is that I will continue to say what I want to, whether I agree with myself or not. I really don't care if many readers agree with me either . . . I only ask that they think.

FOX HUNTING

There has been a substantial increase in interest in transmitter hunts of late. This may be one of the results of increased radio club activities, it may have to do with the sun spot null and a generally enervating situation on the DX bands, or it may be one of those cycles which has yet to be identified as to origin.

Let this be public notice that 73 magazine is interested in getting articles on fox hunting equipment and on unusual fox hunts . . . hopefully with pictures.

Not a few club officers may have detected a correlation between club activities and club membership. Business meetings gradually smother a club, while license study classes and fox hunts lead to more and more enthusiasm . . . and members.

CLUB CLASSES

The bulk of the ham clubs have instituted license study classes and this is rapidly becoming the major interest of most clubs. The number of amateurs the classes are turning out has already had a very positive effect on the amateur licensing situation and the drop off in hams noted for the last few years appears to have been reversed. With more growth of club interest in licensing new hams, the whole Communicator License idea may be out of date long before it ever gets into final rule making. It may turn out that there was no real reason for debasing the ham ticket to get new hams, that a determined effort on the part of the ham clubs was all that was needed. I believe this is true.

If your club has not yet gotten license classes going, raise hell at the next meeting and get things going. If you are short of volunteers to give the code or the theory classes, you could do worse than look into the 73 cassette tapes . . . a great many clubs are using these with satisfaction . . . and they save an awful lot of trouble . . . the work is all done.

Remember the experience of many clubs . . . free classes do much more poorly than those that charge a nominal fee. It is a lot easier to drop out of something where you have little investment, so consider maybe a $7.50 or $10 fee. This will give the club some extra income for teaching materials. If you think I'm talking in terms of buying cassettes . . . I am . . . the whole set for the Novice exam only costs $24 . . . and that includes

Continued on page 152

Icom East is in the Southwest — right? And here are the two Dallas chaps behind Icom East: Tom Gentry and Fred Muller.

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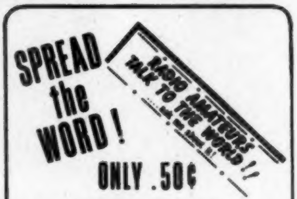
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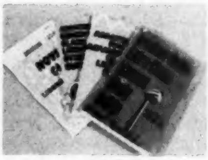

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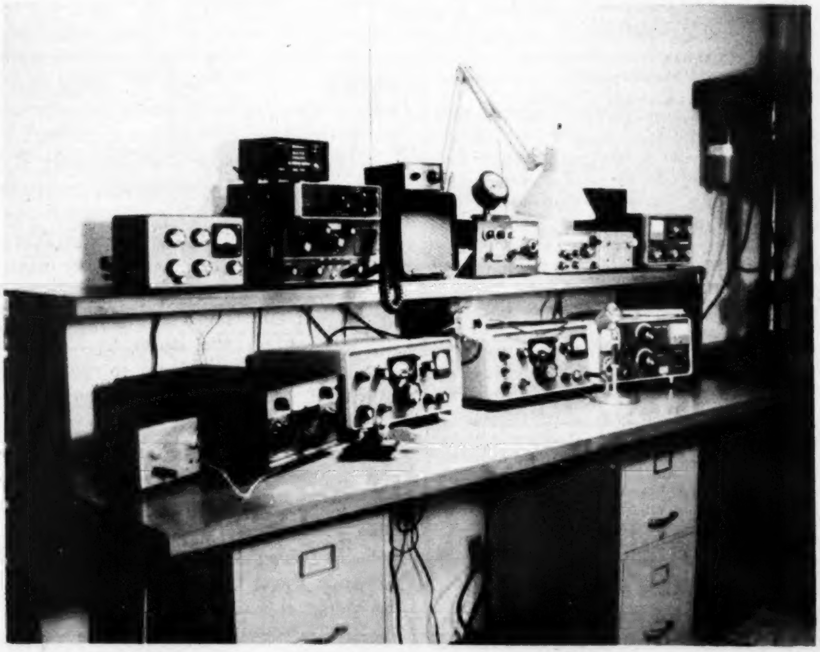

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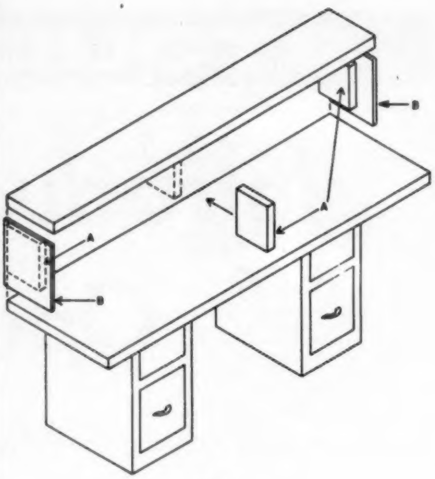

Fig. 1.

wide. I was told that this narrow door was used to construct folding doors. If this narrow door is not available in your area a 2" X 12" will work just as well.

The three pieces labeled "A" are 2" X 6" X 12" and provide support for the upper shelf.

The end pieces labeled "B" are 3/4 inch plywood. The middle "A" piece is held in place by the weight of the equipment on the upper shelf. The two end assemblies (consisting of "A" and "B" glued together with contact cement) are held to the upper and lower doors by long wood screws.

The whole upper desk assembly is not fastened to the file cabinets but rests there of its own weight.

None of the dimensions are critical and probably will vary according to the materials on hand. I would suggest that you get the doors first and then cut everything else to fit. To obtain the doors as cheaply as possible, try visiting one or more lumber stores and ask to see their damaged doors.

You can usually find one or more with only a minor blemish, which can be hidden, and the store will probably part with them for only a few dollars.

A coat of varnish will keep all wood surfaces from becoming dirty and may even convince the XYL to let you bring it into the house.

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The 432er Goes Power - Like 1100 Milliwatts

The success of the low-power 432'er on the air, running only about 150 mW rf output from a KMC 2N2502, which is an excellent device but relatively low power, and the availability of the famous 2N3866 UHF medium power device in a low cost amateur version, lead naturally to the addition of one of these (why stop at one?) to the original system. A study of what is needed to do this reveals quite a list.

The Device

Talks with other people and my own studies so far indicate one candidate and one only, for a low cost rig with dry cell battery power for portable and mobile use on 432 MHz.

Heat Sinking

At 100°C, which is only boiling water temperature, allowable dissipation must be cut down to around 60% for the devices to be used, so if we can keep that case (transistor metal can) close to 25°C we'll do better on the air. We did.

Dc Voltage

This is definitely settled at 13½V, as from a car battery and under modulation you have to allow for times two in collector voltage, which is right up to the 28V rating of a lot of devices. The 2N3866 is a real gem in this respect though, with a 55V rating. Shouldn't have any modulation voltage trouble with it.

Gain

From RCA and Motorola work on popular UHF devices, just don't expect 10 dB on 432 MHz. Prepare to be happy with less, like 6 or 7 dB of gain. Plenty of the latest commercial circuits are shown with gains of from 5 to 7 dB.

Circuit

As you will see, this quickly gets tied into the heat sink design because while a "nice little coil" can be used, it wouldn't conduct or radiate much heat. So lots of nice copper strap is used, with solid metal contact from collector out through several inches of copper.

Neutralization

We just might tackle that one yet, which can be real crazy on 432 MHz. We haven't, so far.

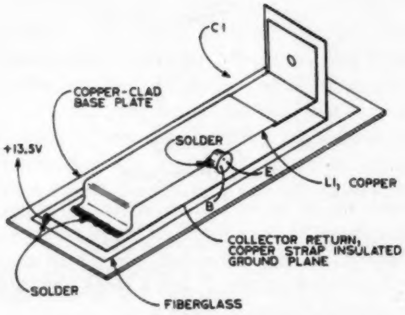

C1
COPPER-CLAD BASE PLATE
+13.5V
SOLDER
E
L1, COPPER
B
COLLECTOR RETURN, COPPER STRAP INSULATED GROUND PLANE
SOLDER
FIBERGLASS

Fig. 1. Good heat sinking at 432 MHz.

Overall Stability

This of course is very important, as you will see later in the section on "Words of caution."

Shielding

We used some. At a milliwatt up front, and 600 mW leaving for the antenna this could be important. But it didn't turn out too badly.

Modulation

We've got a little 3W af amplifier waiting to be used, if the one watter won't do the job. Presumably only ½W is needed.

Dc Milliamps

The total on-the-air-current is getting up there pretty well, but so far not over ½ the maximum of 500 mils indicated by Union Carbide for their lantern batteries. The total came out at 175, so we're still ok on that one.

Collector Efficiency, Final Stage

Most commercial circuits wind up with between 40 and 50%. I'd be happy with that. It actually looks better, like over 50% right now.

Power Out

We're shooting for as much as possible with the 13½V car battery limit. Looks like 600 mW as of now, for one 2N3866 running cool.

Power Measurements

Always troublesome at UHF for a homebrewer amateur, we still managed by using three of those no. 48 bulbs.

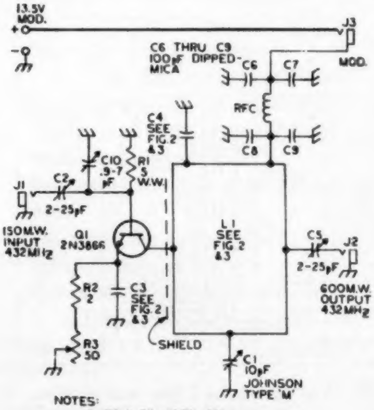
There are probably more things to consider, but here are 13 already.

The 2N3866

If there is any transistor that can take the place, in solid state, of the good old 6AF4 tubes for UHF, this is it. It is apparently the best-known device for UHF. For powers of up to a watt (with 28V) at 432 MHz, and low cost, the 3866 is my choice.

Here's what the RCA "Transistor, Thyristor, and Diode Manual" printed in May 1969 has to say about it: "Transistor dissipation, 5 watts." Yes, five watts! However, the case must be kept at 25 for that amount of power. Further, "rf power output, with 28V dc, 1¼W at 450 MHz." Note that 28V dc again. You could use that much dc but you couldn't use it safely with 100% AM. Anyway you've only got 13½V in the car. And you would have to push it with 200 mW input at that. I really don't see where they get that 5W input figure. I'll have to ask the boys down in Somerville, N.J. the next time down there.

At 400 MHz, efficiency is listed as 45%. We appear to be getting over 50% in this model, so that's all right. So far as gain is concerned, I see listed for this item various figures at and around 7 dB or so, again at 28V. We find 6 dB or so, using 13½V. Good enough in that department.


13.5V MOD.
+
-
J3
MOD.
C6 THRU C9 100pF DIPPED-MICA
C6
C7
RFC
C8
C9
C4 SEE FIG.2 & 3
C10 .9-7 pF
R1 5 W.W.
C2
J1
2-25pF
150MW. INPUT 432MHz
Q1 2N3866
L1 SEE FIG 2 & 3
C5
J2
2-25pF
600M.W. OUTPUT 432MHz
R2 2
C3 SEE FIG 2 & 3
SHIELD
R3 50
C1 10pF JOHNSON TYPE 'M'

NOTES:
1. C2 & C5 ARCO 421.
2. C10 ARCO 400.

Fig. 2. Schematic of the 2N3866 rf power amplifier, 432 MHz.

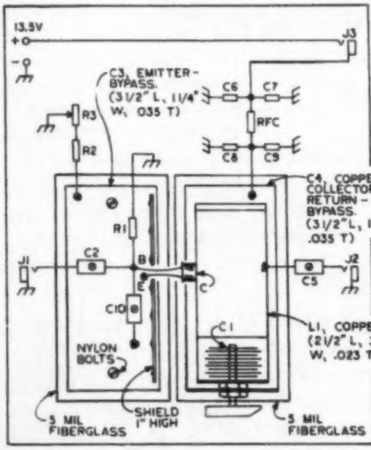
Heat Sinking

This is probably the best place to start the details because that little tin by itself certainly doesn't radiate or conduct much heat. On the other hand UHF circuitry does not do too well with large pieces of metal wrapped around the collector, unless of the proper shape as you will see later.

You could think of a Berlox (RCA trade name for their Beryllium-oxide) collector stud, which is a good conductor for heat waves and at the same time a good insulator for UHF. Quite handy but the cost questions enter then a little too strongly.

But once again, don't worry. We already have a good circuit among several worked out during the development of the 432'er. This is the one using a large copper strap for the collector circuit, soldered to a large copper collector-return ground plane which itself is isolated from ground by an insulating sheet. Figure 1 illustrates this principle.

The collector is soldered directly to L1 (see also Figs. 1, 3, and 4), the copper collector strap, which is ¾ in. wide and high Q. The heat generated in the transistor case can then go directly to L1, and from there with direct metal contact right to the collector-return primary baseboard. Now you have some six or more square inches of copper plus three or four more of insulating sheet contact, which, if needed, can be of mica with silicone grease. I don't think that will be needed though. It wasn't.


13.5V
+
-
J3
C3, EMITTER-BYPASS. (3 1/2" L, 1 1/4" W, .035 T)
C6
C7
RFC
C8
C9
R3
R2
R1
C4, COPPER COLLECTOR RETURN-BYPASS. (3 1/2" L, 1" W, .035 T)
J1
C2
B
E
C
C5
J2
C10
C1
L1, COPPER (2 1/2" L, 3/4" W, .023 T)
NYLON BOLTS
SHIELD 1" HIGH
5 MIL FIBERGLASS
5 MIL FIBERGLASS

NOTES:
1. Q1 SOLDERED TO L1 1 1/2" FROM COLD END.
2. C5 SOLDERED TO L1 1 1/2" FROM COLD END.
3. Q1 BASE LEAD IS INSULATED FROM C3.

Fig. 3. Layout and top view of the rf power amplifier at 432 MHz.

dB	Times, In Power
3	2
4	2½
6	4
7	5
9	8
10	10

Table 1. Power gain.

Also, as you can see from Fig. 1, the collector return plate is at rf ground and therefore can be of any size needed, as long as you can fit it in. It does have the modulation voltage on it, but at a low impedance, looking like about 170 Ohms at present.

With 1100 of dc power L1 hardly even gets warm enough to feel any heat. More details in the circuit section.

A Word of Caution

While most writers of books on solid state devices, and I am including here manufacturer's handbooks, application notes, specifications, etc., naturally enough like to present the merchandise for sale in a finished form ready for the customer to use, some of them do mention trouble once in a while. And I am among the first to congratulate them on a job well done in producing transistors that do last for years and are repeatable and usable at UHF. It certainly isn't easy. My hat is off to RCA in particular, both for producing good devices, and for being realistic about them. An example of this can be seen in their handbook mentioned above, "Various kinds of instabilities can occur in frequency-multiplier circuits, including low-frequency resonances, para-

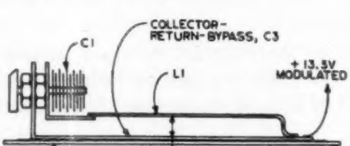


Fig. 4. Side view of the 2N3866 power amplifier at 432 MHz.

metric oscillations, hysteresis, and high-frequency resonances." In particular the "hysteresis" refers to "discontinuous mode jumps in output power when the input *power* or *frequency* is increased or decreased." That last sentence underlines the reason for my continual effort to obtain what I have been calling smooth tuning and operation.

RCA goes on to stress as a main cure for this the use of the grounded emitter. You will notice *all* grounded emitters in my circuits, simply because they work better.

I have to hand it to RCA once more, for their admitting that for UHF and microwaves, plastic packages, with power, have *not* proved satisfactory. They say that the high power combined with the high frequency and the small sizes and small physical separations inside the plastic devices for UHF and up tend to increase the chemical leakage difficulties to a greater extent than with the hermetically sealed units.

That's enough on this subject for now, just don't expect to "solder wire A to post B" and have it perfectly right the first time in solid state UHF. It might, and then again it just might *not*.

Dead Soldiers

As usual I burned one out. However, the methods used (to burn it out) are easy to avoid in this case. 1.) Don't operate without an emitter resistor; and 2.) don't use an old tube power supply in order to see what happens at 28V. I saw all right, operating without the emitter resistor and with that supply, which gave poor regulation (for transistors) at 28V.

I can blame the absence of the emitter resistor on reading too many books. Or is it not enough? I see plenty of circuits *without*

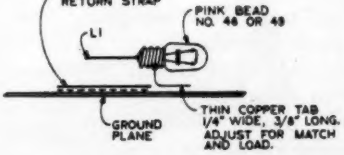
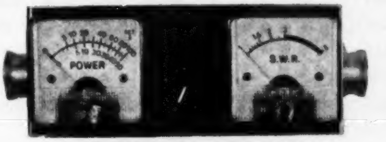

COLLECTOR RETURN STRAP
PINK BEAD NO. 46 OR 48
L1
THIN COPPER TAB 1/4" WIDE, 3/8" LONG. ADJUST FOR MATCH AND LOAD.
GROUND PLANE

Fig. 5A. Side view of rf power indication.



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that resistor but at least with the 3866, don't omit it. It kept locking up at 200 mils with only about 10V on the collector, and I finally found that even a 1Ω resistor in the emitter avoided this special kind of nastiness. You will see 2Ω in the final circuit.

But not before I'd acquired another dead soldier. This came about with that 28V supply, because after checking a lot of gain figures I realized that most of them called for 28V. My actual voltage on the collector at first stood at a low 10, so I plugged in the HV supply and was pushing up the Variac and the 3866 rf output bulbs were beginning to glow like Christmas tree lights, when – POW – something jumped and that was it.

So back to the lantern batteries I went. They say that a man with a house is always coming out of a hardware store. Well, so is a man building a portable battery rig trying for a watt on UHF!

Looking in the books again (it may be fatal but I'm just a hopeless addict I guess) I find most mobile rigs are listed with a 13½V power supply, not just 12V, or 10, as I happened to have. So I cut one of the 6V lantern batteries open and added on a few more cells to the 432'er main supply. It's easy once you open the sardine tin they're packed in, because they're not even soldered together. Anyway, I've got around 14V now, from a battery supply, and things are looking good.

The Circuit

Here we get down to real details, with a few important questions to solve, such as to tune the base or not; value of emitter resistors; collector current, listed as a maximum of 400 mils; what point on L1 to tap on the collector; and where to tap on the output capacitor. All that should give us a good increase over the 150 mW so far available from the 432'er, bearing in mind that the 3866 is a 55V rated transistor and we are shooting for 13½V operation as dictated by a car battery as well as portable use. Figure 2 shows the schematic with component values. Figure 3 has the layout and dimensions, which are very important, of C3, C4, and L1. These are all made out of copper sheet. Figure 4 shows a side view.

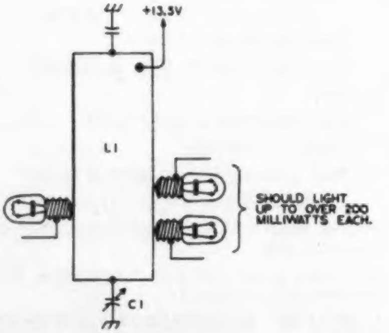

Fig. 5B. Top view, rf power indication.

The Input Circuit

There is a compromise here, as usual. Read the "Word of Caution" section again for some of the reasons. The base circuit can be tuned completely but you really have to watch for self oscillation then. The compromise bit is furnished by C10, which, in the language of the art, "cancels out the inductive reactance of the base and emitter leads." Sure, it does that, which simply means that the base, C10, and the emitter, are now tuned to 432 MHz. But, due to the fact that there are external leads and "things" which are tied on, like the various internal resistances and capacitors inside Q1, some of which vary as each rf cycle progresses, you can really only hope and try. In this case it did give a little boost to the drive, and makes input cable matching more adjustable. With the use of C2 and C10, Q1 can be driven up to 100 mils, and has a nice collector current dip down to about 20 mils, when L1 is not loaded. This is pleasantly reminiscent of the tube final plate dips that were with us for some 30 years past. It also produces a nice visible spark on applying the pencil test.

After trying various chokes and coil combinations, the base resistor R1, a 5Ω wire-wound Sprague, was settled on as producing smooth, non-spurious, non-lockup tuning. It is almost an inch long and acts as a choke as well as limiting the base-emitter current. It works.

The emitter circuit is of course well bypassed by the copper plate job C3, shown in Fig. 3. R2 limits current to prevent lockup and burn-out, and R3 allows adjust-

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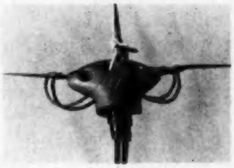

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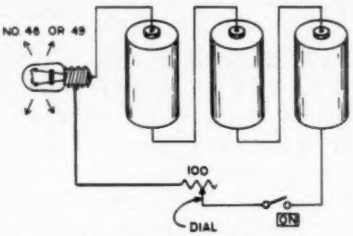

Fig. 6A. Drawing of a sample dial calibration, with 3 dry cells, a 100Ω pot, and one No. 48 bulb.

ment of the collector current which is running around 80 mils just now.

Automatic protection circuits can be used to limit total destructive current, but they require several transistors and diodes and more circuitry, which is not compatible with our main design requirement of the basic power amplifier without frills.

A shield was included as in Fig. 3, and I do not recall any rf feedback oscillation in more than a day of tuning up. The base and emitter leads go through a hole in this shield about 3/8ths of an inch in diameter. Not too critical, I'd say.

The collector is soldered directly to L1, after cutting off the collector wire lead on Q1, which is not used in this 432 MHz rig. Note as mentioned in the heat sinking section that the heat of the metal case of Q1 can now go directly to the copper strap L1 by *metallic* conduction, and then on down to the collector return plate, still by direct metallic conduction, as shown in Fig. 4.

C1 is a 10 pF variable capacitor and with the copper strap L1 shows good sharp tuning when unloaded. It also shows good matching for the transistor impedance and a 50Ω cable output line. Power is taken off L1 through C5 out to J2.

The plus 13½V modulated comes in through J3 and the usual 432 MHz filter previously described. This is ten turns of any wire, wound on a 100K resistor, bypassed by four dipped micas, anywhere from 30 to 1000 pF soldered to ground in four different places.

That about does it for the circuit, and it works!

Rf Power Indication

This has always been a particular problem

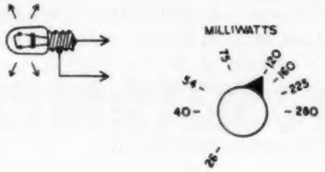

Fig. 6B. Illustration of a low cost rf milliwattmeter.

to accomplish without an expensive power meter, and now with over ½W, it gets even more difficult. To solve it on the bench for the homebrewer I just put more of those number 48 or 49 bulbs on L1, as in Figs. 5A and 5B.

Each lamp is adjusted for the same brilliance by moving the tab capacitors in relation to rf ground. The lamp brilliance is then measured with the "poor man's milliwattmeter" and multiplied by three. If you know an easier and more economical method be sure and let me know.

It turned out to be a total of some 600 to 625 mW, at least. I say at least because the assumption is made that the rf wattage needed to light the bulbs cannot be less than the dc wattage, and may well be higher.

An interesting thing about the 13½V and the evidently low impedance of L1 and Q1's collector circuit, when loaded to 600 mW, occurs when you put your finger directly on the high end of L1. The rf indicator bulbs go dim but you can't put them out with your finger.

Table 1 shows dB versus power just to help with a realistic viewpoint, and shows that as you go from 150 mW to 600 with the 2N3866 you've got 6 dB of gain. As if you didn't know?

Updating the Poor Man's Milliwattmeter

The original one was calibrated only to 150 mW but here we already have over ½W output, and climbing. So, as in Fig. 6A, another D cell was added for a total of three, and the dial recalibrated for use with them, bringing the dc volts to around 4V, and the mils to about 80 for a dc power of 280 mW maximum. A sample calibration dial is shown in Fig. 6B.

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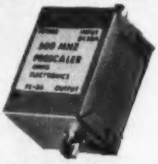

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output circuit glowing like a flashlight when you look into its beam, I measured over 600 mW rf output so far, by checking each one out at over 300 mW brilliancy. In the final setup shown in Fig. 5 with three bulbs each one checked at over 200 mW.

Battery Power Supply

Just a few words about the question of how much battery voltage is advisable. The entire rig is based on the idea of its being carried portable, mobile, and used at home. The mobile mode dictates the voltage because of the car battery. I am assuming that you do not want to go to the expense and trouble of building something like a dc to dc converter for 13½ to 28V. Most mobile circuits are designed for 13½V so that is the figure we'll use here.

In order to take some advantage of the 55V rating of the 2N3866 I added three more dry cells to the two 6V lantern batteries. These cells are the 500 mils type also, which I acquired by removing them from another lantern battery. This gives about 14–15V under the 175 mA total drain of the transmitter without modulation. The reason I added three cells instead of one or two was because of the voltmeter being used. It was about 1V low. The rig will take the 15V all right, it just means I'll have a shade less power when I plug it into the car battery.

So much for batteries, at least of the dry cell type.

Conclusion

There's not much more to say. Here's a complete dry cell battery rig, 600 mW crystal-controlled output on 432 MHz, modulated, and a good triple-conversion receiver to go with it. The units are breadboard style, but the circuits are all there and work well on the air. I intend to have lots of fun with it; mobile, mountain-top, and in the shack. It is working on dry cells you can buy in any hardware store, runs 1120 mW dc input, and beams from two to fourteen elements have been described, as well as a car beam mount, hand-rotatable. A reasonable balance of power vs battery drain is obtained.

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CONTESTS

from page 14

INTERNATIONAL OK DX CONTEST

Starts: 0000 GMT Sunday, November 9
Ends: 2400 GMT Sunday, November 9

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A station may be worked once only on each band. A complete exchange of codes counts one point, but three points for a complete contact with a Czechoslovak station (except as noted above for stations in the same country). The multiplier is the sum of the ITU zones from all bands. Final score is then the sum total of contact points times the multiplier.

CATEGORIES:
A – single operator, all bands; B – single operator, one band; C – multi-operator, all bands. Any station operated by a single person obtaining assistance, such as in keeping the log, monitoring other bands, tuning the transmitter, etc., is considered as a multi-operator station. Club stations may work in category C only.

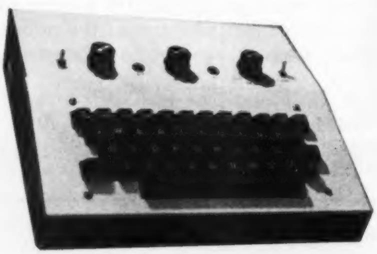
AWARDS:
A performance list of participants will be worked out by the contest committee for each country. A certificate will be awarded to the top scoring operators in each country and each category. The "100 OK" award may be issued to stations for contacts with 100 Czechoslovak stations, and the "S6S" award (and/or endorsements for individual bands) may be issued to a station for the contacts with all continents. Both awards will be issued upon a written application in the log. No QSL cards are required for either award.

LOGS:
A separate log must be kept for each band, and must contain date and time in GMT, station worked, exchange sent and received, points (0, 1 or 3), and ITU zone (with the first QSO for that zone only). The log must contain in its heading the category of the station (A, B or C), name and callsign, address and band or bands. Also, indicate the sum of contacts, QSO points, multipliers and the total score of the participating station. Each log must be accompanied by the following declaration:

> *I hereby state that my station was operated in accordance with the rules of the contest as well as all regulations established for amateur radio in my country, and that my report is correct and true to the best of my belief.*

Logs must be sent to The Central Radio Club, Post Box 69, Prague 1, Czechoslovakia – postmarked no later than December 31, 1975. A list and map of ITU zones is available for 2 IRCs from the same address.

Please send all contest information, including results, directly to WA1SCX. – Ed.



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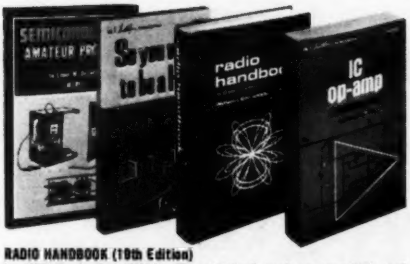

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BE MY GUEST

from page 99

something out with them. As a matter of fact, I think it would be very desirable if the Canadians would track us on CB at 27 MHz.

BOURNE: *Do you have any plans for allowing somewhat of a hobby-type operation on CB, as long as it's going on there anyway?*

HIGGINBOTHAM: We hesitate to use the term "hobby," because we don't want to confuse it with Amateur Radio. But in our proposal in Docket 20120 we did propose to drop the prohibition against chit-chat. I personally am not that hung-up on idle conversations on CB. If they want to get on and talk about their equipment, OK; I just hesitate to call it hobby.

BOURNE: *If they do that, there's even less of a desire, I would think, to get an Amateur license.*

HIGGINBOTHAM: I agree with you.

BOURNE: *Then Amateur Radio would die even faster. If that were allowed, do you think sometime in the future there might be some allowance for Amateurs to operate on 11 meters and talk to CBers, as long as call signs were used by both?*

HIGGINBOTHAM: I haven't thought about that. When we were first talking about Class D within the Commission, I'm absolutely certain that one of the things that we were telling Amateurs — and, of course, that was an Amateur band at the time — was that "You can use the band too." We proceeded from then on to add additional regulations as time went by to tighten up the permissible use of the service. I'm not sure the Amateur community would appreciate a proposal like that.

BOURNE: *If Amateurs were on there talking to the CBers, it could almost give the CBers an incentive to upgrade when the Amateurs tell them what they can do on other frequencies.*

HIGGINBOTHAM: Maybe so. That's a thought.

BOURNE: *Are there any other important proposals or petitions that you are about to act upon?*

HIGGINBOTHAM: We do have the pending petition of APCO to establish one frequency as a nationwide emergency communications channel. We are going to issue that shortly, I think, as a Notice of Inquiry and Notice of Proposed Rule Making, and see what the comments bring in. We are also targeting for a release in July of the Atlanta interservice sharing program that we have been talking about for these several years. The drafting is pretty well along on that, and I think we will be showing it to the Commission probably late in June. This involves land-mobile interservice sharing in Atlanta, Georgia — Parts 81, 89 and 93, the so-called PSIT services.

End of interview.

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If you have ever wanted a digital clock for your shack, now is the time to buy it. Prices on these impressive items have been coming down slowly over the last few years, but when I saw S. D. Sales' recent ad in 73, I didn't believe it.

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Evaluation

The drawbacks of this kit are few. The readouts (.27 in.) may be a bit small if you wish to view the clock from 30 feet away. Of course, you can always substitute larger readouts if you wish. The lack of a case may also be considered a disadvantage by some, but this way you can build it into your station control console or anywhere else you wish.

The first advantage that comes to mind is the price. At a total cost of $12.95 postpaid, including the circuit boards, it can't be beat. The chip, by the way, will read either 12 or 24 hour time, and can be used on 50 or 60 Hz. It can even be used in your car or boat if you're willing to build up a separate time base.

In all, the S. D. Sales Clock Kit is a great buy. If you've been considering building a digital clock, but the prices have been too high, S. D. Sales has just removed your last excuse.

. . . WA2OBH

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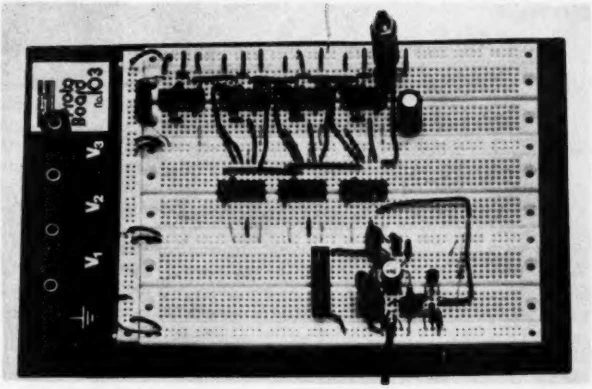

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Looking West

from page 96

exact figure, but at last count there were quite a few pending with no place to put them – on two, that is. In short order, 220 will be in the same position. About the only really wide open space is to be found on six meters, where LA is served by only one open repeater: WA6UJS on Mt. Wilson. It was a combination of these two factors (the uncoordinated repeaters and the fact that we are plum out of spectrum) that was the reason for the SCRA's approach to the FCC to propose a pilot project between the two in matters of the coordination of 144 MHz and 220 MHz repeaters in Southern California. The idea was to put "teeth" into the decisions of the SCRA's coordination efforts and at the same time provide the individual applicant with the most efficient way to get his WR application acted upon.

To summarize the basic points, as outlined in the June letter sent to the Commission, the SCRA proposes that all completed Form 610 As for VHF repeaters in this area be forwarded to the SCRA Technical Committee for review, correction if necessary, and frequency assignment, prior to being sent to the Commission for their action. After FCC processing, the license would be returned to the applicant with a copy of the SCRA sanction attached. The test period would be one year, and during that time period, if any particular applicant felt that he or they had been dealt with unfairly by the SCRA Technical Committee, the applicant could "redress his grievances" directly to the Commission. During the test period, the SCRA would submit progress reports to the FCC on a regular basis and would follow this with a final report and recommendations at the end of the test. After the one year was up, any restrictions imposed by the test would be off. As of this writing in early August, the Commission has yet to respond to the SCRA proposal, but local reaction has been rather pro among the FM community. If this plan were adopted, it would give the SCRA's decisions a bit of solid backing, and would probably put an end to what we at 73 have come to term the "renegade" repeater. While too many of you who live in smaller communities that are served by a handful of machines with plenty of spectrum to spare might find it a bit hard to believe, the fact is that many of the larger urban areas have reached the point of total saturation on two meters, and, as I said earlier, we here in LA and vicinity will soon face the same situation on 220. 450? . . . I cannot speak for the rest of the nation, but as for the W6 call area, it's been full for over 10 years now.

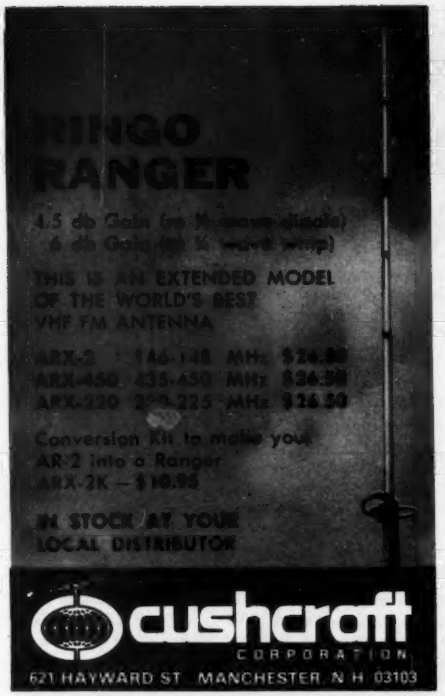
In discussing this proposal with others, both here and in other parts of the country, the only really negative comment I have heard is that bringing the Commission directly or even indirectly into the frequency coordinating business might just be inviting disaster. It is admitting that we, the "self-policing" amateur service, cannot do the job ourselves and therefore must request outside aid. The thought is that this could lead to more restrictive legislation at a time when we are fighting very hard to liberalize what we are now burdened with. But, do we let Joe Blow just blatantly disregard the rights of the rest of the amateur FM community so that he can have his super ego trip repeater on the air at the cost of an already established system? Will we get to the point where a channel pair on two meters will be the hard won prize for those who show the most contempt for those already operating in that spectrum? Will we be forced to live with confrontation after confrontation until such time as only the fittest survive? I sure hope not.

What alternatives are there, though? One that I have discussed with Wayne seems to make quite a lot of sense. Let's for the moment call it "Right of Redress of Grievances by Repeater Councils to the FCC". Following this thought, if a repeater were to come on the air uncoordinated, cause hardship to already established systems, and refuse to cooperate with the rest of the amateur community, then a given coordinating group that was recognized by the Commission as having the responsibility for coordination in a given area could petition the Commission and request that the license of the system in question be suspended until such time as they were willing to cooperate with the coordinating council and, more important, with their peers on the given repeater subband. First, taking action in this way would show that a coordinator has at least tried to solve the problem before throwing up his hands and running for help. It would require those responsible for area coordination to make every possible effort to find a place for the new system and take an active interest in the general welfare of *all* users of a band. Moreover, it would force a coordinator to carefully follow every minute action in a given situation and be ready to provide the necessary documentation on a matter, should same be requested by the Commission. On the other hand, it would give the operator of the system in question a chance to learn the art of mutual cooperation and that this "art" does benefit all concerned, while at the same time giving said system owner the right to make his views heard by the Commission if he feels that he has a valid reason for acting in the way he has. In other words, it would keep the Commission out of frequency coordination of repeaters and instead only involve them when cases of interference to a given coordinated system was taking place due to the appearance of an uncoordinated "renegade" system. This method would keep the actual policing within our ranks where it must remain, while developing a tighter working dialogue between the Coordinating Council and the FCC. I suspect that there are other alternatives, and if you have anything along these lines, please write to me so that your ideas can be shared with the rest of the nation.

A few months ago I might have said that the time is fast approaching when some action along these lines would soon be a necessity. With more than half a dozen such unsanctioned operations in this area and with who knows how many others in the other crowded urban areas, the time, fellow hams, is now.

SAROC Hawaii: Was it great or was it a bust? I have heard many conflicting reports on this item, but LW was lucky in that it had its own quasi-official observer present in the form of my good buddy Bill Orenstein KH6IAF/6. Bill will use just about any excuse to head west over the blue Pacific for a Hawaiian Holiday, and SAROC Hawaii was as good as any. So while I baby-sat his IC-230, FT-224 and other assorted VHF radios, Bill made the five hour non-stop trek to those beautiful islands. About 10 days later, at 3 am, he showed up back here in LA with a lot to say about SAROC itself and other aspects of Hawaiian VHF FM. We will cover all this and more next month when we see you Looking West . . .

. . . WA6ITF



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Danger: Back Issues

It has been brought to our attention that a large number of amateurs have been fired from their jobs and been divorced by their hitherto resigned wives — the trouble turns out to be in many cases tied to the receipt of a large bundle of back issues of 73 Magazine! Apparently this has caused the recipients to become so engrossed that they have essentially lost contact with the world. Several cases of near starvation due to aggravated engrossment have been reported. Authorities have been asked to prohibit the further distribution of back issue bundles of 73 on humanitarian grounds. Until these slow-witted authorities act, 73 has agreed to continue to ship these dangerous bundles — and at no increase in price . . . 25 back issues (our choice) $5.00 plus $1.50 for postage and handling.

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HP-65 USERS exchange ideas, programs, methods. Monthly newsletter. Request information and sample newsletter. Richard Nelson, 2541 W. Camden Pl, Santa Ana CA 92704.

VHF ANTENNA 6.8 dB gain, 18' fiberglass w/50' ½" aluminum coax $150. John A. Wheaton, PO Box 182, Williston Park, NY 11596.

CALL LETTER LICENSE PLATES – still being collected by 73 Magazine for possible cover use. Please send in an old call letter plate – most treasured are out-of-district plates such as W2NSD/NH, etc. Got any real oldies? 73 Magazine, Peterborough NH 03458.

GREAT LAKES DIVISION CONVENTION – October 10 & 11, State Fairgrounds, Columbus, Ohio. Many activities planned for hams and their families: flea market, forums of all types, Ohio Village tours, ceramics class, etc. $2,000 in prizes include TR4-C & two R4-C's. Advance registration $2.50. Write Mary Gibb W8RVP, 293 Ceramic Drive, Columbus OH 43214.

FOR SALE: HP-45 superscientific with nicads, charger, etc. Condition: new. $265. (201) 233-7068 after 5:00. Ask for Bryan, or write to Box 1237, Mountainside NJ 07092.

MOTORHOME for sale. 25 ft. Sportscoach (RB) – 1973 – excellent condition – many extras. Antennas – 2 mtr. TV, (2) HF – 4 KW generator, sleeps six. $1,500 down, assume loan. Send SASE for more info. W6KHS, 212 Magellan St., Capitola CA 95010.

MEMPHIS is beautiful in October! The Memphis Hamfest, bigger and better than ever, will be held at State Technical Institute, Interstate 40 at Macon Road, on Saturday and Sunday October 4 and 5. Demonstrations, displays, MARS meetings, flea market, XYL entertainment, prizes. Informal dinners Saturday night. Dealers and distributors welcome. Talk-in on 3980, .34-.94 and MARS. Contact Harry Simpson W4SCF, Box 27015, Memphis TN 38127 or telephone (901) 358-5707.

JIG SAW PUZZLES wanted. If you have any old wooden jig saw puzzles in your attic – or run across them at an auction (they go for 25¢ usually), please keep in mind that Wayne Green collects them and might even pay a buck apiece for them. c/o 73 Magazine, Peterborough NH 03458. Wood, not cardboard – and complete.

LOOKING FOR JAN 1961 issue 73 Magazine. Please write, stating price, only mint condition. All letters answered. R. H. Wilson, 4011 Clearview Drive, Cedar Falls IA 50613.

COLLINS 30S-1, excellent, new 4CX-1000A, $1050, alpha 374, brand new, in warranty $975, Techtronics 310A with cart $250. Sid Sidman, 3571 Gresham Ct., Pleasanton, Calif. 94566.

RADIO ARCHIVES, amateur ANECDOTES (then & now) solicited for proposed (SASE subscription) monthly PR newsletter. Electronic Avocations, 3207 fourth St. N., Mpls., Mn. 55412.

IT PAYS TO ADVERTISE IN 73

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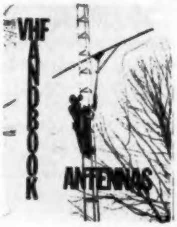

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from page 127

the four tape Novice theory set plus the code intro and 6 wpm back breaker practice tapes.

HAM SKIERS TO MEET

HTs add quite a bit to skiing, cutting down on boredom on the lift lines and while going up in the chair lifts. This last winter hams got together for skiing on quite a few weekends, with up to seven HTs going at times. It was a ball.

The plan is to get as many hams together at Aspen for the January 4-10th week as possible. It should be a lot of fun. If you ski and can get away for the week, bring your HT set up for 146.52 and join the crowd.

There'll be some beginners as well as some gung ho snow scorchers like Chuck WA1KPS of Tufts Radio. If you can make it, drop me a line – I'll be there for sure, complete with HT and a charger. If there is finer skiing anywhere in the world, I've missed finding it. Aspen also has some of the greatest restaurants.

Get your skis out and be there.

SUPER DXPEDITION

Captain Burke of the Windjammer Cruises is looking for a licensed amateur to operate the ham station aboard the Yankee Trader. This is a ten month around-the-world cruise, complete with visits to a lot of very rare spots, skin diving, and loafing. The regular fare for the trip runs about $25 per day – and there is a whopping discount for a ham to help provide phone patches back home.

Contact Capt. Burke, Box 120, Miami Beach FL 33139.

LOCAL NEWSCASTS

Another feature being developed for repeaters is the ability to run off a short cassette on demand with current news of the repeater group. The most used system so far for this uses TT number 9. This is an excellent way to make meeting times and other club events known to everyone using the repeater. It can also be expanded, if you have an interested newscaster, to include the latest ham news flashes. Don't make it too long, as the service can quickly get to be a bore for the more persistent listeners.

...W2NSD/1

LETTERS

from page 21

STRAIN DRAIN

Probably ten years ago I typed the invitations to NZART branches in Auckland to hear Wayne Green and then couldn't get to hear him. However, we worked on the air and he sent me a sample copy of *73 Magazine*; I ordered the back copies and have been hooked since. Copies arrive pretty punctually and are very welcome. Always glad to see projects for beginners to do home construction so easily missed as an experience if one sticks to commercial equipment only.

Congratulations on the Study Courses and Code Tapes and their evident success. 73 continues from success to success. Our Public Library has it as its only subscribed radio magazine and one of the local bookshops has copies on sale. I feel, too, that Wayne has a team around him that has taken away the strain of earlier days in turning out the magazine.

Father Phil Keane
Gisborne, New Zealand

FITS THE BILL

Just a short note to let you know that 73 is one fine magazine. Fits the bill perfectly at this QTH. Especially appreciate your construction articles by K2OAW. Keep up the fantastic job.

James Billman WB8MWE
Willard OH

OLD MAGS

My husband, who was W2JRX (and also a radio technician) passed away in May of 1974. We have 73 Magazines from 1964 to 1975, QST from 1942 to 1972 and CQ from 1947 to 1970. A few magazines have been sold for 25¢ each. Could you please tell me if I could sell these or how I should go about it. We also have some CB magazines, as well as radio equipment. Would appreciate any help you can give me, and thanks for your trouble.

Mrs. W. Waterman
55 Lake Ave.
Middletown NY 10940

'VETTE SAVING

On July 11, 1975 at 6:40 am EDT, while mobiling on I-271 near Cleveland OH, my wife and I spotted a towed car on fire (one of many beautiful 'vettes seen that am). Through the fine WR8ABD repeater, Tom K8MMM was contacted. He called the State Police, who immediately gave chase to save the day, and the 'vette.

Ted Holt WB6IPR
Keene NH

SENECA ON THE WARPATH

I have a Heathkit Seneca, which has the controlled carrier modulation which causes the current meter to vary with the modulation. I would like to know if any of your readers would have a circuit which would overcome this movement by the needle, somewhat like the TX86 which had a grid modulation but did not cause these oscillations.

Harry Penders
611 Turf Lane
Conshohocken PA 19428

FORAGING FOR A FRONT END

I am in the process of building a frequency counter using TIL306 and '308s and have got the PC layout for everything but a front end. The counter measures freq. to 100 MHz and I need to go to 300. I have a 95H90 and a 9582, and would like to find out if anyone has used these two devices in a front end and if they have would they be willing to part with the schematic. PC layout is not needed as I have the facilities to do the board layout.

Kirk R. Mellnick
803 Lufbery Dr.
Seymour Johnson AFB
North Carolina 27530

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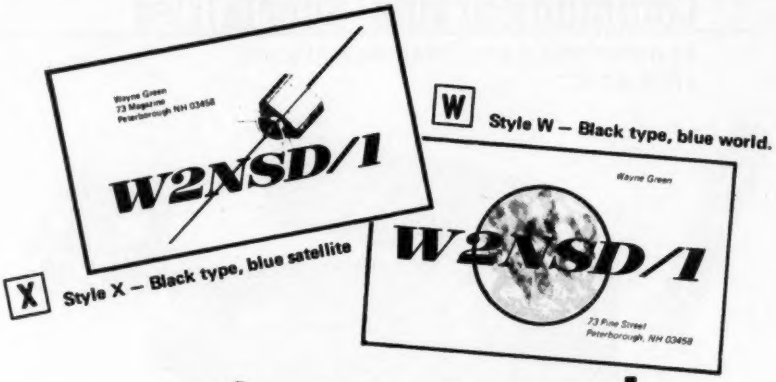
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☐ **14 WPM** Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test you'll thank heavens you had this back breaking tape.

☐ **6 WPM** This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly – under pressure – faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five. Practice this one during lunch, while in the car, anywhere and you'll be more than prepared for the easy FCC exam.

☐ **21 WPM** Code is what gets you when you go for the Extra Class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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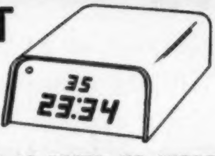

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Karl Schulte WA2KBZ

Ham PR vs Chaos

Splashing through the wind-swept lake which had been a parking lot only minutes before, I surveyed the sad, soaked remnants of what had been the grandest

Dale Reif, Rolling Meadows' Woman of the Year for 1975, visited the station and made several contacts (under WB9IDJ's supervision).

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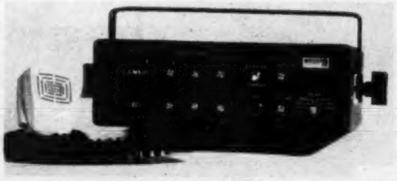

Brimstone 144 142-149 FM

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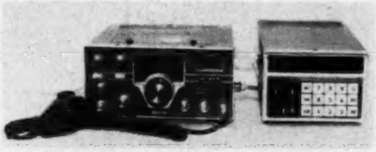
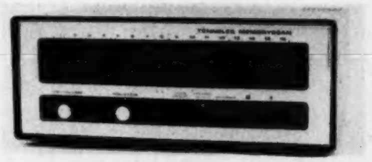


ICOM 21-A
ICOM DV-21
146-148



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parade our city had seen. Soggy floats, all but dissolved into giant, amorphous fruit salads, stood abandoned helter-skelter, while everywhere were bandsmen, spectators, and even clowns dashing for whatever shelter they could find. Trying to bring order to chaos, while braving the incredible torrential downpour, were the town's police and Civil Defense members. All was lost, and the Twentieth Anniversary Celebration of Rolling Meadows, Illinois, was washed out at the height of the festivities.

But not all was lost, for as the door to our park building opened, the musical notes of a CW contact were heard, and on 20 phone, a KL7 was giving congratulations on the anniversary to WT9RMI. This was our town's special event station, set up to bring added publicity for both the town and our new Civil Defense Radio Club, which sponsored the operation.

We had an omen of bad weather the night before, as Doug (WB9IDJ), Rich (WB9DED), Ken (WB9QLD), and myself set a record for erecting antennas, with incentive and inspiration being provided by an ominous and rapidly approaching electrical storm. Convinced the weatherman wasn't fooling, we luckily elected to set up inside the park HQ building, rather than in a tent. A good choice, I thought, as I stood dripping in the doorway, for the operators were the only folks around who were warm and dry, and whose plans were not ruined by the rain.

The Anniversary station was the idea of WB9IDJ and Merril Wuerch WN9PRB, who is the Director of Civil Defense as well as an Alderman for the city. Being enthusiastic about ham radio, and wishing to establish a Rolling Meadows radio club, sponsored by Civil Defense, Merril gave the go ahead.

AMATEUR RADIO STATION
WT9RMI
20TH

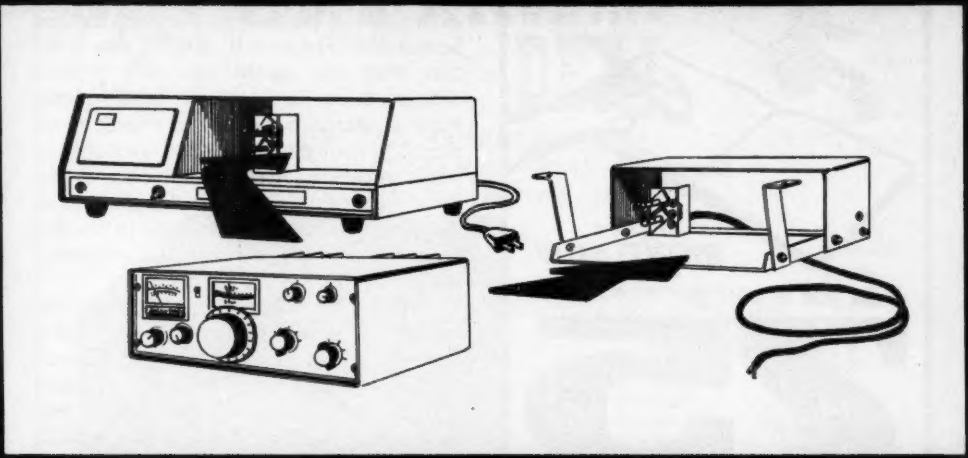
Karl (WA2KBZ) and Pat and Don Whiting (balloon owners) get ready for test flight. Note PR on side of basket.

A letter was written to the FCC requesting the call WT9RMI, for the *t*wentieth anniversary of *R*olling *M*eadows, *I*llinois. Arrangements were made with the park officials for permission to operate on park grounds adjacent to the parking lot where most of the people would be, to provide for maximum exposure. Special QSLs were designed for the station, and equipment, antenna materials, and operators were lined up. We were all set to go – except for the license; although ample time had been allowed, there was still no sign of it, and the time was growing short. (There is no such thing as applying for a license too early.) A call to the FCC reassured us; it was in the mail, and in fact did arrive in the nick of time.

The actual operation was a success, and achieved our goals of both helping the town to spread the word of the anniversary and to kick off our new club – not to mention having a lot of fun doing it! A nice side effect was the front page PR received in the local newspaper, and the surprise "Balloon Aeromobile" operation. That's an example of one of the ways to add a little "zing" to a club event.

As our main operation got under way, WB9IDJ and I noticed a hot air balloon being set up behind our "shack". Having the same idea, we approached them with a Regency HR-2A, equipped with whip and battery, and with our best charm. After presenting our request to go up with a radio,

"QRX OM . . . Changing QTH . . .



. . . from ham shack to mobile. Will be back on in a minute."

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You have full coverage of all bands (except 10 meters, where coverage is 28.4 to 29.4 MHz). The Model 210x covers 10, 15, 20, 40, and 80 meters. The 215x covers 15, 20, 40, 80, and 160 meters.

MODEL 210x or 215x	$649
MODEL 220-CS AC CONSOLE	$139
MODEL 200-PS PORTABLE AC SUPPLY	$ 95
PLUG-IN MOBILE MOUNT	$ 44

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we waited anxiously for the owners' decision. Don and Pat Whiting, owner and chief pilot of the Infinite Horizons Balloon Service (Mt. Prospect IL 60056), nice folks that they are, agreed and even became curious about ham radio. The two sports make a natural combination. Flying at an altitude of roughly 200 ft, we were able to make some long haul (for Illinois and low power) contacts, while enjoying the unique thrill of a balloon ride! We hope to try this again in the future, perhaps in conjunction with races.

Returning to the main operation, we worked 25 states, including Alaska, and a number of European, Asian and Central American stations, including Russia, Panama, and Mexico. However, one of the most interesting QSOs had to be the contact with another special events station, WI9NDY, who was operating at – you guessed it – the Indy "500".

In closing, thanks should be offered to the many amateurs, officials, and folks in general who helped to make this special event possible.

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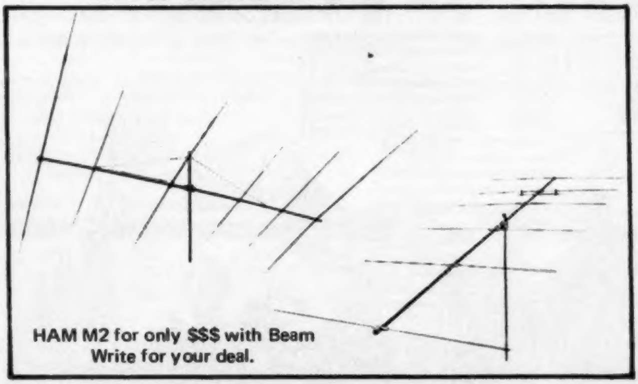

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Busy Hams Benefit Baja

"Buenos dias, mis amigos . . . XE1ZQ/portable, San Vicente." Queta McFarland's crisp, feminine voice is loud and clear. All guys on 3855 MHz, "The Taco Net," eagerly click their mics, hoping to be first. "W6WMO, Hal, here . . . greetings, Queta" . . . "W6YSP, Wes . . . how's the school coming?" . . . Others greet her: JC (K6MVF), Nick (K6DBJ), Mac (WA6DTB), George (W6JC), Ed (XE2EBE), Aida (XE2BY).

Queta knows our limited Spanish, so switches: "The kids are done digging the ditches for the water pipe. We're ready for you . . . W6HCD, are you there, Nash?" – Sure he's there! He's president of Foothill Chapter of "Flying Samaritans," in charge of San Vicente school construction work. "Hola, Queta, como esta?" (Nash took a 6-weeks leave of absence from JPL where he works on Technical Staff, to attend a concentrated Spanish course in Mexico.) "We'd better ask W6RYX if POA's plane is ready for next weekend . . . you there, Pat?"

The QSO goes on throughout the evening. Plans are made to pick up tools, parts and

From left: Nash W6HCD, Mrs. Irene Peterson (sister of Pat), Pat W6RYX, checking through airport customs with Mexican customs official and two workers heading towards San Vicente for work weekend. People of Action's airplane 3681-B keeps busy most weekends flying personnel and equipment as coordinated over Taco Net and ham radio between Mexico and United States.

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73 MAGAZINE

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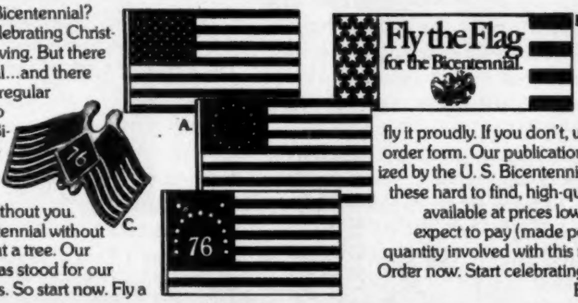

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medicines. Dates are set for work weekends. You'll find these hams here most every night. Think of the time, fuel and expenses saved! Hurray for amateur radio! Queta's using a donated rig, an antenna built by Nash and the rig tuned and serviced by Pat. This amateur radio station is the only means of communication for efficiently bringing down proper equipment and manpower. Through its use, San Vicente has a school and a water system built to U.S. standards. The 4000 feet of plastic pipe were laid in ditches dug by boys from the school, under Queta's supervision.

It's gratifying to see 73 Magazine spread its horizons to include more than technical data from amateurs. I agree with Wayne, our ham guys are gutsy! I'll bet most of you are involved in some philanthropic endeavor right now. When you have an eyeball with your group, aren't you amazed at the many skills of hams? If you're not a flyer yourself, most likely the fellow beside you is – or a boater – a photographer – or motorcycle buff. I've learned a lot about hams while sharing a cup of coffee, a pot of chili at a picnic or a swap meet. A gal doesn't have to send CW, or read a schematic, to talk their language. And what a mixture of talents . . . intellects . . . with the sincere desire to help others!

Just mention, for instance, a mission to Mexico coming up in Baja. The engineer drawing the diagram on his napkin suddenly stops. The photographer quietly lays aside his viewer and slides. The pilot's story is cancelled. "What can we do to help?" "Does your plane have an extra seat?" There's a couple of active hams in Southern California who will quickly get you involved; you heard them on the Taco Net, but let's get a little better acquainted with them.

Nash W6HCD has been an active ham for many years. You couldn't count the number of hours he spends in the shack, shuffling notes, coordinating projects, contacting pilots and hams re Mexico trips. "You'd be surprised," he says, "how many pilots are hams, and how many hams hold highly skilled jobs. Yet, busy as they are, they answer yes when I need a landscape layout, architectural design, water analysis or just plain labor."

Queta McFarland, left, and workers smile as Bob Carbinier brings in huge flow of water from newly installed well at San Vicente, Baja, Mexico – made possible by amateur radio operators' coordination between Mexico and U.S.

Pat W6RYX got his amateur license at age 15. Now he's executive director of "People Of Action," a non-profit group which owns a twin Bonanza airplane. Pat tells us: "POA simply means we're a bunch of people who believe in action; in fact, our slogan is 'serving others worldwide.' We're a tool for *all* organizations."

These two have now completed the QSO by setting a firm date for a work weekend in San Vicente. Should we go along? You have to get up before the sun, to be on time for 3681-B's departure. We clear customs at Tijuana, then 40 minutes later, our ETA is confirmed as we sight the ham antenna above the school grounds. Making a pass over the village to announce our arrival, Pat carefully descends over the hill at the end of the runway and lands "on the numbers" of the short, bumpy, dirt strip of 1900 ft., only 3/4ths of which is usable.

Work starts right after Queta's refreshments. Pat and Nash get busy on the rig replacing the flat final tubes with some donated by Nash. They check the frequency calibration with Pat's General Radio frequency counter model 1192-B; tune the rig

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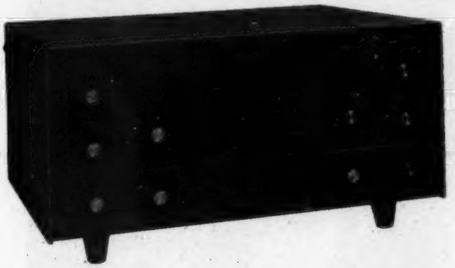

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San Diego's Town & Country Hotel hosted July's Colegas y Amigos Breakfast, where 200 hams met to discuss cooperation between Mexico and U.S. Shown above with VHF Engineering 2 meter repeater display for Ensenada Amateur Radio Club XE2EBC, left-to-right, Father Ryan W6HBP, Pat W6RYX, Earl K6SMT, Al XE2AVG, and with microphone, Fred W7VQQ observing operation of the repeater. "Dos Metros Amigos" will participate in Mexican fiestas, where American hams can share the use of the Ensenada repeater.

using his Bird - 43 · Watt meter. Then contact is made with Mexican hams for any emergencies. Meanwhile, Bob Carbinier, engineer for Waterworks & Utilities Div. of LA., loads supplies into the truck; Leonard Shortlund, Assoc. Harbor Planning Coordinator for L.A. steps on the gas; and they're gone for the day. They'll check the flow of water from the gas driven centrifugal pump, connect the pipe and storage tank. Volunteers from San Vicente listen carefully as they're taught how to lay the pipe and finish the work necessary before our next trip down.

I take my camera and notebook to record the story. The school portrays the results of many Americans who have left personal pleasures and families behind, to help repair generators, set up a clothing shop, donate supplies, etc. There's a small fence around one dormitory — installed by kids from Nash's church one weekend. You can feel their pride as I snap pictures and talk to the natives . . . But daylight ever ends too soon; night is at hand; no more pictures; work still undone. There's always more work than personnel!

Darkness brings a weary, dirty and hungry crew to Queta's. Did you ever eat "cactus burgers?" Mmmmm . . . served with minudo soup, frijolis and topped off with hot apple pie — an American flourish learned from Queta's late husband, Tico. A call from the ham shack indicates stateside hams are inquiring as to our safe arrival. While the "Taco Net" is in progress, a few of us are off to attend an all night fiesta, invited by one of the workers to his wedding party. Here, too, like the day itself, the night passes much too quickly.

These work weekends in Baja are the finishing touches of projects that germinate over the ham frequencies. Most weekends Pat keeps 3681-B's luggage space loaded

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with repaired rigs, antennas and parts. Nash also encourages nurses, doctors and workers to cover short-distance villages by car (a good excuse for use of the portable rig!). They drive many miles from Southern California to Tijuana, Guadalupe Valley, El Testerazo, Ensenada, San Vicente, Colnett and other small villages.

"Well, we must go . . . can't get in too late." (There's one in every crowd!) The ham shack gets straightened, operation manual updated, tools loaded in the airplane. All passengers settle deep into the comfortable seats, as we dip our wings farewell to San Vicente. Another mission to Mexico is completed . . . thanks to the miracle of two-way radio, and to the active, aggressive and astounding amateurs we call "hams."

. . . PATTERSON

If you want to get involved in some of this, here's where you can get information: Pat Patterson, "People of Action", P.O. Box 2352, Palos Verdes, CA 90274; phone (213) 541-7379. – Ed.

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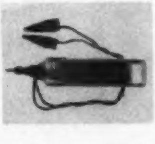

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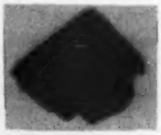

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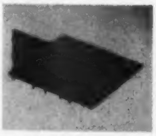

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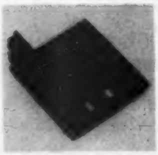

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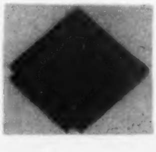

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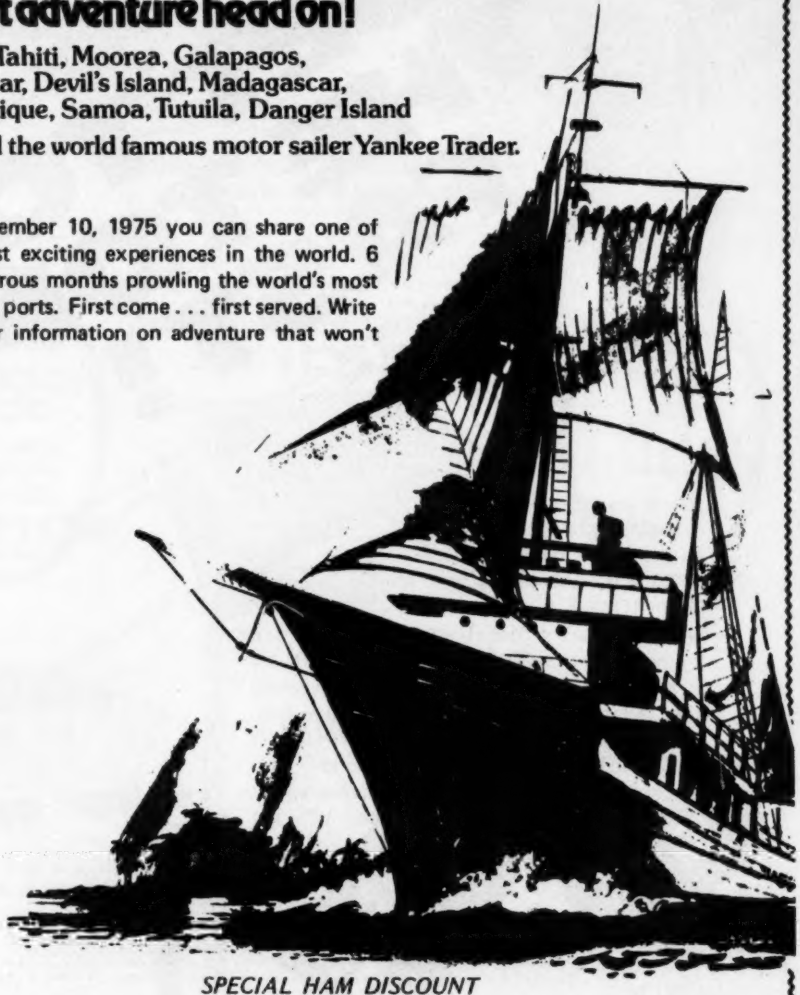

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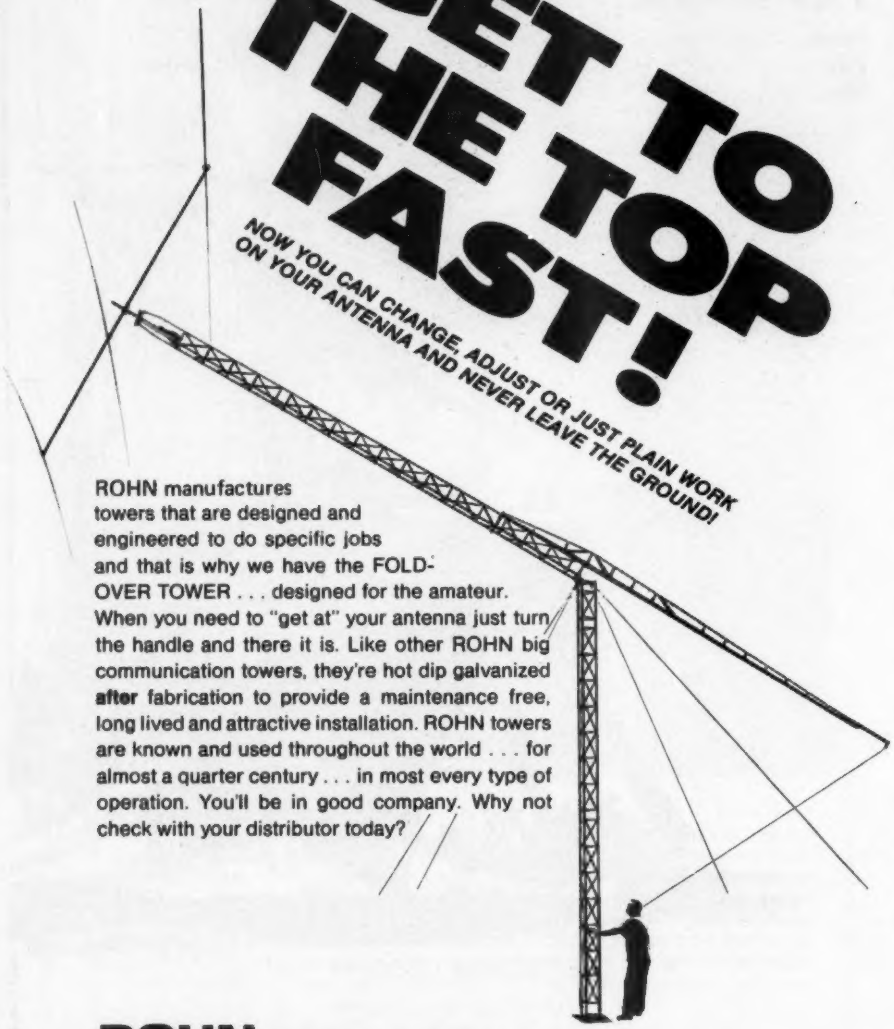

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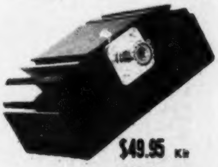

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7404	.25	7492	.80
7405	.25	7493	.80
7406	.45	7495	.90
7407	.45	7496	.85
7408	.25	74107	.50
7409	.25	74121	.60
7410	.20	74122	.60
7411	.30	74123	1.10
7413	.85	74125	.65
7416	.45	74126	.65
7417	.45	74141	1.25
7420	.20	74150	1.70
7430	.20	74151	1.00
7432	.30	74153	1.40
7437	.50	74154	1.70
7438	.50	74157	1.40
7440	.20	75161	1.50
7442	1.10	74161	1.70
7446	1.45	74164	2.00
7447	1.45	74165	2.00
7448	1.45	74166	1.75
7450	.20	74174	2.20
7451	.20	74175	2.20
7453	.20	74176	1.60
7454	.20	74177	1.35
7473	.45	74181	3.90
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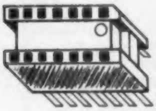

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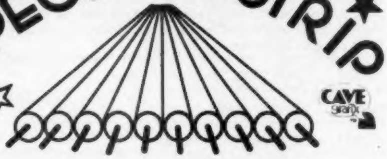

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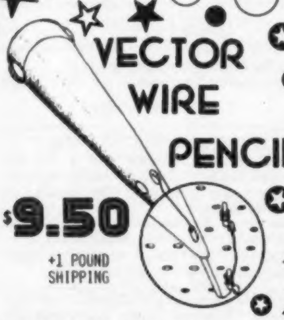

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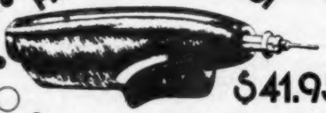

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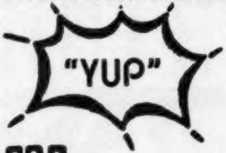

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100 pf	.05	.04	.03	.022	.06	.05	.04
220 pf	.05	.04	.03	.047	.06	.05	.04
470 pf	.05	.04	.035	.1	.12	.09	.075

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.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
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.15	35V	.28	.23	.17	2.2	25V	.31	.27	.22
.22	35V	.28	.23	.17	3.3	25V	.31	.27	.22
.33	35V	.28	.23	.17	4.7	25V	.32	.28	.23
.47	35V	.28	.23	.17	6.8	25V	.36	.31	.25
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1.0	35V	.28	.23	.17	15	25V	.63	.50	.40

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1	50	.16	.14	.11	.47	50	.16	.14	.11
3.3	50	.16	.13	.10	1	16	.15	.13	.10
4.7	25	.16	.14	.12	1	25	.16	.14	.11
10	25	.15	.13	.10	1	50	.16	.14	.11
10	50	.16	.14	.12	4.7	16	.15	.13	.10
22	25	.17	.15	.12	4.7	25	.15	.13	.10
22	50	.24	.20	.18	4.7	50	.16	.14	.11
47	25	.19	.17	.15	10	16	.14	.12	.09
47	50	.25	.21	.19	10	25	.15	.13	.10
100	25	.24	.20	.18	10	50	.16	.14	.12
100	50	.35	.30	.28	47	50	.24	.21	.19
220	25	.32	.28	.25	100	16	.19	.15	.14
220	50	.45	.41	.38	100	25	.24	.20	.18
470	25	.33	.29	.27	100	50	.35	.30	.28
1000	16	.55	.50	.45	220	16	.23	.17	.16
2200	16	.70	.62	.55	470	25	.31	.28	.26

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$ .70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.55	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

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16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	1.75	1.55	1.40

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14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.23	.22	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.36	.37	.36				

SOLDERTAIL STANDARD (TIN)

14 pin	$.30	.28	.26	28 pin	$ .99	.90	.81
16 pin	.33	.31	.29	36 pin	1.39	1.26	1.15
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4 Cond.	.49 ft.	.39 ft.
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16 Cond.	1.49 ft.	1.19 ft.
32 Cond.	2.49 ft.	1.99 ft.

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MAN 7	Com. Ano.	.30	1.50
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DISCRETE LEDS

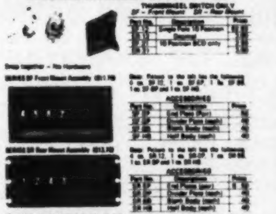
MV 10	Red	5/$1.00
MV 50	Red	6/$1.00
MV 5024	Red	5/$1.00
MV 5024	Green	4/$1.00
MV 5024	Yellow	4/$1.00
MV 5024	Orange	4/$1.00
MV 50*	Red 1½" Leads	5/$1.00

4' POWER SUPPLY CORDS . . . .

Black

SPECIAL
3/$1.00

THUMBWHEEL SWITCHES



Ordering: Order desired switch or switches and add necessary accessories for your particular application.

NEW PROTO BOARD-100

Here's a low cost, big 10 IC capacity breadboard kit with all the quality of QT Sockets and the best of the Proto-Board series . . . complete down to the last nut, bolt and screw. Includes 2 QT-35S Sockets; 1 QT-35B Bus Strip; 2 5-way binding posts; 4 rubber feet; screws, nuts, bolts; and easy assembly instructions.

COMPLETE KIT . . .
*Special $17.95

POCKET CALCULATOR KIT

5 function plus constant – addressable memory with individual recall – 8 digit display plus overflow – battery saver – uses standard or rechargeable batteries – all necessary parts in ready to assemble form – instructions included. 3" x 5¼" **SPECIAL $12.95 each**

OPTIONS –
115VAC Transformer . . . . 4.95 each
6 each "N" Alkaline Batteries . . . . . . 1.95 lot

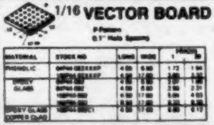
.394" DIAM. TRIMMER

STANDARD RESISTANCE VALUES
MODEL 100Ω 500Ω 1K
2K 5K 10K 20K
100K 200K 1Meg

SPECIAL
Model
TR II

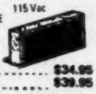
RESISTANCES	1–9	10–99
STD 100Ω 1 MEGΩ	4/$1.00	

1/16 VECTOR BOARD



P-Pattern
0.1" Hole Spacing

WALL or T.V. DIGITAL CLOCK



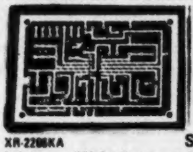
12 or 24 Hour
115 Vac
25' VIEWING DISTANCE
Walnut Case-6" x 3" x 1"
Hr. & Min.-6" High
Seconds-3" High
KIT - All Comp. & Case $34.95
Wired & Assembled $39.95

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea:	10 OHM- 27 OHM-	12 OHM- 33 OHM-	15 OHM- 39 OHM-	18 OHM- 47 OHM-	22 OHM 56 OHM	1/4 WATT 5% = 50 PCS.
ASST. 2	5 ea:	68 OHM- 180 OHM-	82 OHM- 220 OHM-	100 OHM- 270 OHM-	120 OHM- 330 OHM-	150 OHM 390 OHM	1/4 WATT 5% = 50 PCS.
ASST. 3	5 ea:	470 OHM- 1.2K	560 OHM- 1.5K	680 OHM- 1.8K	820 OHM- 2.2K	1K 2.7K	1/4 WATT 5% = 50 PCS.
ASST. 4	5 ea:	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	1/4 WATT 5% = 50 PCS.
ASST. 5	5 ea:	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	1/4 WATT 5% = 50 PCS.
ASST. 6	5 ea:	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	1/4 WATT 5% = 50 PCS.
ASST. 7	5 ea:	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	1/4 WATT 5% = 50 PCS.

IC'S EXAR KITS

FUNCTION GENERATOR KIT



features sine, triangle and square wave, THD 0.5% typ., AM/FM capability

XR-2206KA **SPECIAL $17.95**
Includes monolithic function generator IC, PC board, and assembly instruction manual.

XR-2206KB **SPECIAL $27.95**
Same as XR-2206KA above and includes external components for PC board.

TIMERS

XR-555CP	Monolithic Timer	SPECIAL	$ .89
XR-320P	Precision Timer		1.55
XR-556CP	Dual-555 Timer		1.85
XR-2556CP	Dual Timing Circuit		3.20
XR-2240CP	Programmable Counter/Timer	SPECIAL	3.25

PHASE LOCKED LOOPS

XR-210	FSK Demodulator		5.20
XR-215	High Frequency PLL		6.60
XR-567CP	Tone Decoder (mini DIP)		1.95
XR-567CT	Tone Decoder (TO-5)	SPECIAL	.99

STEREO DECODERS

XR-1310P	PLL Stereo Decoder	3.20
XR-1310EP	PLL Stereo Decoder	3.20
XR-1800P	PLL Stereo Decoder	3.20

WAVEFORM GENERATORS

XR-205	Waveform Generator		8.40
XR-2206CP	Monolithic Function Generator	SPECIAL	4.49
XR-2207CP	Voltage-Controlled Oscillator		3.85

OTHER EXAR IC'S

XR-1468CN	Dual + 15V Tracking Regulator	SPECIAL	2.95
XR-1488N	Quad Line Driver		5.80
XR-1489AN	Quad Line Receiver		4.80
XR-2208CP	Operational Multiplier		5.20
XR-2211 CP	FSK Demodulator/Tone Decoder		6.70
XR-2261	Monolithic Proportional Servo IC System w/4 ea. Driver Transistor		3.79

Special Requested Items

RC4194	Dual Track V Reg	$5.95	N8T97	$3.00	2533	$7.95
RC4195	±15V Track Reg	3.25	8224P	2.25	8263	5.95
F9368	Decoder	3.95	2513	11.00	8267	2.75
LD110/111	DVM Chip Set	25.00	2518	7.00	8288	1.15
CA3130	Super CMOS Op Amp	1.49	2524	3.50	8826	3.00
MC1408L7	A/D	9.95	2525	6.00	8880	1.35
F3341	FIFO	6.95	2527	6.00	7497	5.00

ZENERS–DIODES–RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	3.3	400m	4/1.00	IN4003	200 PIV	1 AMP	.10
IN751A	5.1	400m	4/1.00	IN4004	400 PIV	1 AMP	.10
IN752	5.6	400m	4/1.00	IN3600	50	200m	6/1.00
IN753	6.2	400m	4/1.00	IN4148	75	10m	15/1.00
IN754	6.8	400m	4/1.00	IN4154	35	10m	12/1.00
IN965B	15	400m	4/1.00	IN4734	5.6	1w	.28
IN5232	5.6	500m	.28	IN4735	6.2	1w	.28
IN5234	6.2	500m	.28	IN4736	6.8	1w	.28
IN5235	6.8	500m	.28	IN4738	8.2	1w	.28
IN5236	7.5	500m	.28	IN4742	12	1w	.28
IN456	25	40m	6/1.00	IN4744	15	1w	.28
IN458	150	7m	6/1.00	IN1183	50 PIV	35 AMP	1.00
IN485A	180	10m	5/1.00	IN1184	100 PIV	35 AMP	1.70
IN4001	50 PIV	1 AMP	.09	IN1186	200 PIV	35 AMP	1.80
IN4002	100 PIV	1 AMP	.10	IN1188	400 PIV	35 AMP	3.00

TRANSISTORS

MPS-A05	5/1.00			PN4249	4/$1.00
MPS-A06	5/$1.00	PN3567	3/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3568	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	PN3569	4/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3704	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3705	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3706	5/$1.00	2N4409	5/$1.00
FN2415	5/$1.00	2N3707	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3711	5/$1.00	2N5087	4/$1.00
2N2906A	4/$1.00	2N3724	$.65	2N5088	4/$1.00
2N2907A	5/$1.00	2N3725	$1.00	2N5089	4/$1.00
2N2925	5/$1.00	2N3903	5/$1.00	2N5129	5/$1.00
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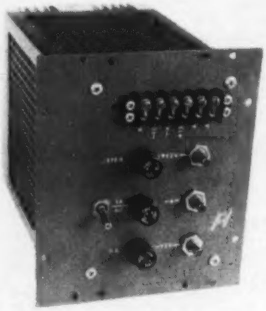

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Like new, a value for the touch tone pad alone. Desktop model with cradle phone. Made by Automatic Electric.

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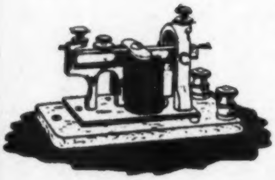

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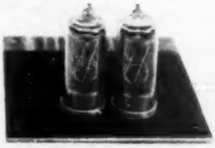
#SP-115 $15.00 2/$25.00

NIXIE BOARD $2.50

Unused PC board with 2 nixies B-5750S mounted and pins terminating on PC board edge. Useful for counters, clocks, etc. Numerals 1/2 inch high. 180 volt neon.

#SP-206 $2.50



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YOU ASKED FOR IT! Found only at Poly Paks at this l-o-w price! It's ONLY 1 3/4 x 1 3/16 x 3/8" deep panel. Designed specifically for our MM-5316 fluorescent driving clock chip. Indicates 4-digits, AM-PM, pulsating second indicator, requires minimum of parts to build. Color: BLUE-GREEN; you can use RED or GREEN filters. Character height: 0.5". Filament voltage is 1.75 VAC or DC @ 160 mils. Anode voltage 25V @ 250 microamps per segment. With spec sheets, clock construction diagrams, P.C. board layouts, specs. A DIGITAL CLOCK BUILDER'S SPECIAL.

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4-Function Arithmetic 22 KEYS!

$16.95 ☐

It's the easiest multi-function kit today!

KIT INCLUDES: case, 22-key keyboard kit, ON-OFF switch (part of keyboard) PC board, driver and memory calculator chips, 9-digit "bubble" magnifier LED array, array cable, AC adapter jack & wires, battery case, 6 battery card display, instruction and pictoral step-by-step construction booklet. AC/DC too!

- DOUBLE MEMORY
- Percent, Constant, Display Restore

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☐ 1N4003	200	10 for 65c
☐ 1N4004	400	10 for 75c
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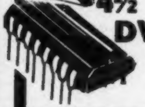
☐ 1N4007	1000	10 for 1.29

4½ DIGIT DIGITAL VOLTMETER DVM CHIP



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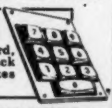
Type MM5330 by National utilizes P channel low-threshold enchancement mode devices and ion implanted depletion mode devices. Provides logic circuit for 4½ digit DVM. TTL compatible.

With instruction sheets and diagram on "how-to-build a 4½ digit DVM". Ideal with our Litronix ½" single, 1½" and dual digits. 16-pin DIP.

Touch Tone KEYBOARD KIT ☐ $4.95

Kit includes 4 x 2½" G-10 glass etched pc board, with 10 OAK "smooth touch" white keys with black numerals, plus diagram on "touch tone encoder". Makes many "keyboard systems" readily available. *0-to-9*



☐ **555** Timer 2 for $1

or

☐ **558** Dual 741 3 for $1

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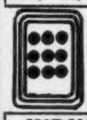

This unit is not advertised — anywhere! Made for Motorola Communications at the original cost of $4.50 each (for insertion in their Walkie Talkie Program). It's a 60-ohm imp MIKE. It's an excellent speaker too, covering broad range in sound. Extremely well-made.

NATIONAL LM-340T VR's

- TO-220 Case
- 1 Amp
- POSITIVE VOLTAGE

$1.75 Each

Buy 3 — Take 10%

Type	Volts
☐ LM-340-05T	5 v
☐ LM-340-06T	6 v
☐ LM-340-08T	8 v
☐ LM-340-12T	12 v
☐ LM-340-15T	15 v
☐ LM-340-18T	18 v
☐ LM-340-24T	24 v

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☐ MAN-4AB	.27	Red	1.95	5.00
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☐ MAN-7	.27	Red	1.00	2.50
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ALL ABOVE BY MONSANTO

MAN-1
MAN-3
MAN-4

Type	Size	Color	Sale	3 for
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☐ SLA-1	.33	Green	1.95	5.00
☐ SLA-1	.33	Yellow	1.95	5.00
☐ SLA-3	.7	Green	4.95	12.00
☐ SLA-3	.7	Yellow	4.95	12.00
☐ 707	.33	Red	1.95	5.00
☐ 704A	.33	Red	1.95	5.00
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A—Common Cathode, others Common Anode
B—With bubble magnifier
C—Plus or Minus 1

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☐ 727E	.5	Red	5.95	15.00
☐ 746F	.6	Red	3.95	11.00
☐ 747	.6	Red	3.95	11.00

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E—Dual digits
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☐ SN7407	.35
☐ SN7408	.19
☐ SN7409	.19
☐ SN7410	.16
☐ SN7411	.25
☐ SN7413	.59
☐ SN7414	1.65
☐ SN7416	.34
☐ SN7417	.34
☐ SN7420	.16
☐ SN7412	.45
☐ SN7423	.29
☐ SN7425	.29
☐ SN7426	.25
☐ SN7427	.29
☐ SN7430	.16
☐ SN7432	.25
☐ SN7433	.49
☐ SN7437	.34
☐ SN7438	.34
☐ SN7440	.16
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☐ SN7442	$.70
☐ SN7444	1.25
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☐ SN7446	1.15
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☐ SN7451	.17
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☐ SN7472	.29
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☐ SN7485	1.25
☐ SN7486	.37
☐ SN7488	3.95
☐ SN7489	2.45
☐ SN7490	.59
☐ SN7491	1.10
☐ SN7492	.59
☐ SN7493	.59
☐ SN7494	.95
☐ SN7495	.79
☐ SN7496	.79
☐ SN74100	1.40
☐ SN74104	.44
☐ SN74105	.44
☐ SN74106	.52
☐ SN74107	.44
☐ SN74108	.89
☐ SN74112	.89
☐ SN74113	.89
☐ SN74114	.89
☐ SN74121	.49
☐ SN74122	.48
☐ SN74123	.85
☐ SN74125	.59
☐ SN74126	.59
☐ SN74132	1.75
☐ SN74140	2.10
☐ SN74145	1.05
☐ SN74148	2.25
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			1	$\boxed{2}$	③	$\boxed{4}$
5	6	7	8	9	10	11
12	$\boxed{13}$	⑭	⑮	⑯	$\boxed{17}$	$\boxed{18}$
$\boxed{19}$	$\boxed{20}$	21	22	23	24	$\boxed{25}$
㉖	㉗	$\boxed{28}$	29	30	31	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7A	7	7	7	3	3	3	7	7	7A	14	14
ARGENTINA	14	7	7	7	7	7	14	14A	21	21	21	14A
AUSTRALIA	14	7B	7B	7B	7	7	7	7	14B	14B	14	14A
CANAL ZONE	14	7	7	7	7	7	14	14	14A	21	21	14A
ENGLAND	7	7	3	3	7	7	14	14	14A	14	7A	7
HAWAII	14	7B	7B	7	7	7	7	7B	14B	14	14A	14
INDIA	7	7B	7B	7B	7B	7B	14	14	7B	7B	7	7
JAPAN	14	7B	7B	7B	7	3	7	7	7	7B	7B	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14A	14
PHILIPPINES	7A	7B	7B	7B	7B	7	7	7	7	7B	7B	7A
PUERTO RICO	7	7	7	7	3	3	7A	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7B	7A	14	21	21	14	14	14
U. S. S. R.	7	3	3	3	7	7B	14	14	14	7B	7	7
WEST COAST	14	7	7	7	7	3	7	14	14	14	14	14A

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	3	3	3	7	7	14	14	14
ARGENTINA	14	7	7	7	7	7	7	14	21	21	21	21
AUSTRALIA	21	14	7B	7B	7	7	7	7	14B	14B	14	21
CANAL ZONE	14	7	7	7	7	7	7	14	14A	21	21	21
ENGLAND	7	7	3	3	7	3	7B	14	14	14	7A	7B
HAWAII	14	14	7B	7	7	7	7	7	7B	14	14A	14A
INDIA	7A	7A	7B	7B	7B	3B	3B	7A	7A	7	7B	7B
JAPAN	14	7A	7B	7B	3	3	3	7	7	7B	7B	14
MEXICO	7A	7	7	7	7	3	7	7A	14	14	14	14
PHILIPPINES	14	14B	7B	7B	3B	3B	3B	7	7	7	7	14
PUERTO RICO	14	7	7	7	7	7	7A	14	14	14A	14A	14
SOUTH AFRICA	7	7	7	7	7B	7B	7A	14	14A	14A	14	14
U. S. S. R.	7	3	3	3	3A	3	7	14	14	7B	7B	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7A	7	7	3	3	3	7	7	14	14	14
ARGENTINA	14	7A	7	7	7	7	7	14	14A	21	21	21
AUSTRALIA	21	21	14	7B	7	7	7	7	7	14B	14	21
CANAL ZONE	14	7	7	7	7	7	7	14	14A	21	21	21
ENGLAND	7B	7	3	3	7	3	3B	7	14	14	7A	7B
HAWAII	21	14A	14	7	7	7	7	7	7A	14	21	21
INDIA	7A	14	7A	7B	3B	3B	3B	7	7	7	7	7
JAPAN	14	14	7B	7B	3	3	3	7	7	7B	7A	14
MEXICO	14	7A	7	7	7	7	3A	7A	14	14	14	14A
PHILIPPINES	14	14	7B	7B	3B	7	7	7	7	7	7B	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14A	14A
SOUTH AFRICA	7A	7	7	7	7B	7B	7B	14B	14	14	14A	14
U. S. S. R.	7	3	3	3	3	3	3	7	7A	7A	3B	7B
EAST COAST	14	7	7	7	7	3	7	14	14	14	14	14A

A = Next higher frequency may be useful also.
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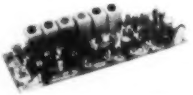

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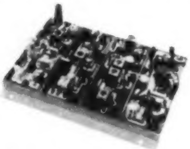
TX144B W/T	factory wired	49.95
TX220B Kit	exciter – 1 watt – 220 MHz	29.95
TX432B Kit	exciter – NEW – 432 MHz	39.95



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RX144C Kit	140-170 MHz rcvr w/2 pole 10.7 xtal filter	69.95
RX144C W/T	factory wired / mounted	114.95
RX220C	210-240 MHz rcvr w/2 pole xtal 10.7 filter	69.95
RX432C Kit	NEW – 432 MHz receiver	79.95
RXFL	70DB filter option for all RX-Recv (w/exch.)	9.50

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PS12C W/T	factory wired	85.95
PS24C Kit	24 amp – 12 volt regulated power supply w/case	99.95
PS24C W/T	factory wired	114.95

RPT144 Kit	2 meter – 15w – complete	364.95
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RPT144	NEW – 15 watt 2 meter repeater – factory wired	595.95
RPT220	NEW – 15 watt – 220 MHz repeater – factory wired	595.95
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